

## ARTICLE

# Evaluation of umbu-caja germplasm in the state of Bahia, Brazil

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**ABSTRACT** – *The umbu-caja is a tree native to the Northeastern region of Brazil, with promising perspectives of economic use. Aiming to detect variability in the species, 43 umbu-caja genotypes were identified in 14 counties of the state of Bahia, Brazil. Fruits of these genotypes were collected for physical, chemical and physico-chemical analysis. The range of variation of all analyzed traits was large. Among genotypes, there was, however, predominance of pear-shaped to slightly pear-shaped fruits, fruit weight ranging from 15 g to 27 g, pulp/seed index around 2.0, total titratable acidity between 1.5 and 2.6%, total soluble solids between 9.0° and 14.0° Brix, and vitamin C content ranging from 3.6 to 16.4 mg ascorbic acid 100g pulp<sup>-1</sup>. The presence of seeds in genotypes ranged from 5 to 100 % of fruits without seeds.*

**Key words:** *Spondias*, selection, genetic variability, plant breeding.

## INTRODUCTION

The umbu-caja (*Spondias* sp.) is a tree of the family Anacardiaceae. As well as caja and umbu, the umbu-caja is a tropical fruit tree native to the Brazilian Northeast, easy to propagate, with promising perspectives for the internal and external market of tropical fruits, especially in the form of pulp, juice and ice cream (Campbell and Sauls 1994, Donato 1991, Ritter 1993).

The genetic diversity of native populations of umbu-caja is apparently wide, and should be evaluated and preserved in germplasm collections to avoid the risk of loss of genetic plant material, mainly genotypes of agronomic and industrial value. Presently, the available knowledge on the genetic variability of umbu-caja is poor and needs to be enlarged, to maximize the use of the economic potential of this crop. The purpose of this study was therefore the characterization and

evaluation of umbu-caja genotypes identified in the state of Bahia based on traits of agronomic and industrial interest, aiming at the selection of the best genotypes for production systems and plant breeding.

## MATERIAL AND METHODS

Forty three umbu-caja genotypes were identified in the following counties in Bahia: Santa Terezinha (seven genotypes), Cabaceiras do Paraguaçu, Iaçú and Milagres (five genotypes each), Santa Bárbara (four genotypes), Amargosa and Itatim (three genotypes each), Cruz das Almas, Irará, Santo Estevão and Tanquinho (two genotypes each), Coração de Maria, Santanópolis and Sapeaçú (one genotype each). Collection expeditions were carried out in the months of March to June 2000 and March 2001, during the period of fruit maturation and harvesting of the species. During these expeditions, it was observed that the umbu-caja

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plants were found mainly in transition ecosystems between Atlantic Forest and Caatinga, always close to residences, indicating a strong dependence on the human presence for propagation and dispersion.

Ten fruits of each genotype were collected and taken to the Laboratory of Science and Food Technology of Embrapa Cassava and Fruits for physical, chemical and physico-chemical analysis, including fruit weight, length and width, pit weight, skin color, pH, total soluble solids, ascorbic acid and total titratable acidity contents. The amount of seeds was evaluated in 20 fruits per genotype. The pH was measured with a pH meter and the total soluble solids content with a Brix refractometer. The total titratable acidity content was obtained by 0.1 N NaOH titration and the ascorbic acid content by the Tillmans' method, modified by Benassi (1990).

## RESULTS AND DISCUSSION

The variability in the analyzed umbu-caja genotypes was high for the fruit traits evaluated. The fruit shape varied from well-defined or slightly pear-shaped (63% of the genotypes) to ovate (35% of the genotypes) and round (2% of the genotypes) (Figure 1). The mean fruit weight ranged from 13 to 27 g, so that in six genotypes (14%) weight was less than 15 g. For 21 genotypes (49%) fruit weight varied from 15 to 20 g and in 16 genotypes (37%) the mean fruit weight was over 20 g. In direct relation with the fruit size, the fruit length and width ranged from 3.1 to 4.8 cm and from 2.6 to 3.4 cm, respectively. The pulp/pit ratio varied from 1.0 to 9.3; in 13 genotypes (30%) the ratio was lower than 2.0, in 23 genotypes (54%) the ratio varied from 2.0 and 2.5 and in seven genotypes (16%) the ratio was above 2.5 (Table 1).

**Table 1.** Fruit physical traits of 43 umbu-caja genotypes collected in 14 counties of the state of Bahia, Brazil, in 2001

Genotype	Fruit				Fruit	Weight (g)		
	Skin color <sup>1</sup>	Shape <sup>2</sup>	Length	Width		Pulp	Pit	Pulp/Pit
Santa Terezinha								
CampoGrande1	Y	SP	3.6	3.1	19.9	14.6	5.3	2.7
CampoGrande2	Y	SP	3.8	3.0	19.1	13.3	5.8	2.3
CampoGrande3	Y	OV	3.9	3.3	23.9	17.9	6.0	3.0
CampoGrande4	GY	RO	3.1	2.9	13.9	12.6	1.3	9.3
CampoGrande5	DY	SP	3.7	3.1	19.5	14.2	5.3	2.7
JoãoBrandão	Y	OV	3.5	3.1	17.4	12.6	4.8	2.6
Vargem Grande	Y	SP	3.5	3.0	17.0	11.0	6.0	1.8
Itatim								
PontaAguda	Y	PE	4.7	3.2	23.7	15.8	7.9	2.0
SerraGrande1	Y	SP	3.9	3.2	23.3	16.2	7.1	2.3
SerraGrande2	Y	PE	4.8	3.4	25.4	16.7	8.7	1.9
Sapeaçu								
Berré	YG	OV	4.0	3.3	22.6	15.3	7.3	2.1
Cabaceiras do Paraguaçu								
PédeSerra	Y	PE	3.5	2.7	12.6	8.3	4.3	1.9
PéSerraViração	Y	PE	4.4	3.2	24.7	16.9	7.8	2.2
RuadasPedrinhas	Y	SP	3.5	2.9	17.9	12.0	5.9	2.0
OlhoDágua	Y	OV	4.1	3.4	25.7	17.5	8.2	2.1
Jacarezinho	Y	OV	3.6	2.8	16.7	12.0	4.7	2.6
Santo Estevão								
SítioMagalhães	Y	SP	3.7	2.9	15.5	10.3	5.2	2.0
Araújo	Y	OV	3.8	3.4	24.1	16.1	8.0	2.0
Iaçu								
LagedodeDentro	Y	PE	3.8	3.0	18.1	12.2	5.9	2.1
FrentedaLagoa	Y	PE	4.4	3.2	25.0	17.5	7.5	2.3

to be continued

Genotype	Fruit					Weight (g)			Pulp/
	Skin color <sup>1</sup>	Shape <sup>2</sup>	Length	Width		Fruit	Pulp	Pit	Pit
					Iaçu				
AcessoRochoso	Y	PE	3.7	3.0		18.8	13.0	5.8	2.3
RuaSantaRosa	Y	PE	4.4	3.2		24.2	17.3	6.9	2.5
Vavazinho	Y	PE	4.5	3.1		22.6	19.1	3.5	5.5
					Cruz das Almas				
SítiodoTercinho	YG	PE	4.2	3.1		19.5	11.8	7.7	1.5
EmbrapaSPM	Y	PE	3.9	2.9		16.1	9.4	6.7	1.4
					Milagres				
DeusDará1	Y	PE	4.0	3.0		20.3	13.7	6.6	2.1
DeusDará2	Y	OV	3.7	3.1		18.6	12.6	6.0	2.1
LagoadaBebedice1	Y	PE	4.0	3.0		18.9	13.5	5.4	2.5
LagoadaBebedice2	Y	PE	3.6	3.0		17.7	12.5	5.2	2.4
BaixadasCueranas	Y	OV	3.4	3.0		14.8	10.1	4.7	2.1
					Amargosa				
Amargosa1	Y	OV	3.6	3.2		20.9	14.7	6.2	2.4
Amargosa2	Y	PE	3.7	3.1		18.8	12.5	6.3	2.0
Bela Vista	Y	PE	3.8	2.7		13.5	8.5	5.0	1.7
					Coração de Maria				
Faz. Cordeiro	Y	OV	3.4	3.1		15.5	9.3	6.2	1.5
					Irará				
Faz. Juazeiro1	Y	OV	3.2	2.8		12.8	6.5	6.3	1.0
Faz. Juazeiro2	Y	OV	3.6	3.0		18.5	12.7	5.8	2.2
					Santanópolis				
Faz. Lamarão	Y	OV	4.1	3.3		27.2	19.1	8.1	2.3
					Santa Bárbara				
Cruzeiro	Y	SP	3.7	2.8		16.2	10.0	6.2	1.6
Burdão	Y	OV	3.8	3.2		22.1	12.8	9.3	1.4
Renovado1	Y	OV	3.5	3.0		17.0	11.7	5.3	2.2
Renovado2	Y	PE	3.6	2.6		13.8	7.5	6.3	1...2
					Tanquinho				
Cangaceiro	Y	PE	3.8	3.1		20.0	13.2	6.8	1.9
Primavera	Y	PE	4.0	3.3		25.5	16.6	8.9	1.9

<sup>1</sup> Skin color: Y = yellow; DY = Dark yellow; YG = yellow green; GY = green yellow.

<sup>2</sup> Shape: OV = ovate; PE = pear-shaped; SP = slightly pear-shaped; RO = round.

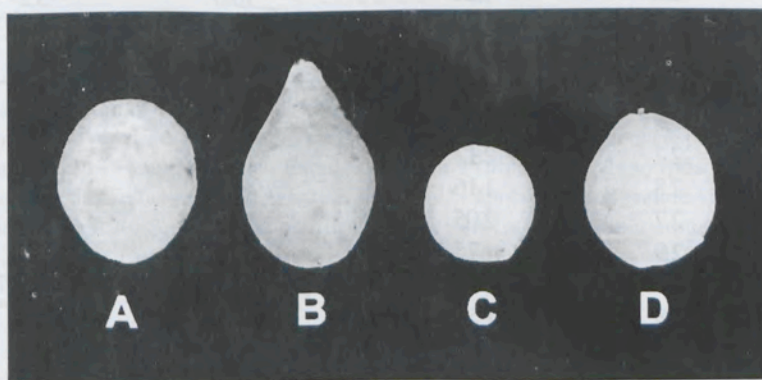


Figure 1. Different shapes of umbu-caja fruits: (A) ovate; (B) pear-shaped; (C) round; (D) slightly pear-shaped

In the juice analysis (Table 2) the pH varied from 2.4 to 3.3. The total titratable acidity (TTA) content ranged from 0.9 to 2.6% citric acid, and the acidity of two genotypes was lower than 1.0%; in nine genotypes the acidity ranged from 1.0 to 1.5%, and in 26 genotypes the acidity was higher than 1.5% but lower than 2.0% and in six genotypes the acidity was higher than 2.0%. The total soluble solids (TSS) content ranged from 7.2 to 14.0° Brix; in six genotypes (14%) the values were lower than 9.0° Brix, in 29 genotypes (67%) the TSS content ranged from 9.0 to 11.0° Brix and in eight genotypes (19%) the TSS content was above 11.0° Brix. The TSS /TTA ratio varied from 3.7 to 10.6; in 25 accessions (58%) the values for this ratio were lower than 6.0, in nine genotypes (21%) the ratio was between 6.0 and 7.0 and above 7.0 in other nine genotypes (21%). The TSS/TTA ratio was relatively low in most genotypes, possibly due to their high TTA contents. The ascorbic acid (vitamin C) content ranged from 3.6 to 16.4 mg ascorbic acid 100g pulp<sup>-1</sup>, and was generally low, compared with the contents of fruits such as orange and lemon, with about 50 mg ascorbic acid 100g pulp<sup>-1</sup>.

On average, 46% of the fruits were seedless, with a variation among genotypes of 5 to 100% seedless fruits. In our sampling, 19 genotypes (44%) had 50% or more seedless fruits. Considering this high percentage, it is suggested to take this trait into account in the selection of umbu-caja genotypes for use as rootstocks.

Based on the evaluations, the genotypes 'Campo Grande 5' and 'Vavazinho' were preliminarily selected as promising, based on the traits large fruits and high pulp content, considered as most important in the selection for yield. 'Vavazinho' also stood out with low acidity and 'Campo Grande 5' has a quite intense yellow fruit color, which is very desirable for juice and ice cream production.

## CONCLUSIONS

The genetic variability of umbu-caja in the State of Bahia is high enough for genotype selection with a view to breeding varieties for commercial production systems.

**Table 2.** Fruit chemical and physico-chemical traits of 43 umbu-caja genotypes collected in 14 counties of the state of Bahia

Genotype	pH	TTA (%) <sup>2</sup>	TSS (°Brix) <sup>3</sup>	TSS/TTA	Vitamin C <sup>4</sup>
Santa Terezinha					
CampoGrande 1	2.8	1.59	9.0	5.7	14.6
CampoGrande 2	2.8	1.45	8.8	6.0	13.5
CampoGrande 3	2.7	1.38	8.6	6.2	15.0
CampoGrande 4	3.3	0.95	7.8	8.2	3.6
CampoGrande 5	2.8	1.74	9.2	5.3	7.8
JoãoBrandão	2.7	1.87	9.6	5.1	14.4
Vargem Grande	3.0	1.51	9.0	6.0	3.8
Itatim					
PontaAguda	2.8	1.71	12.0	7.0	9.2
SerraGrande	2.6	1.85	9.6	5.2	14.8
SerraGrande	2.6	1.94	10.0	5.2	11.5
Sapeaçu					
Berré	2.7	2.57	11.0	4.3	15.0
Cabaceiras do Paraguaçu					
PédeSerra	2.8	1.69	12.0	7.1	16.4
PéSerraViração	2.7	2.12	14.0	6.6	9.9
RuadasPedrinhas	2.8	1.16	8.4	7.2	9.5
OlhoDágua	2.7	2.05	11.0	5.4	11.4
Jacarezinho	2.9	1.75	11.0	6.3	7.8
Santo Estevão					
SítioMagalhães	2.8	1.51	9.8	6.5	6.6
Araújo	2.7	1.82	9.4	5.2	12.1

to be continued

Genotype	pH	TTA (%) <sup>2</sup>	TSS (°Brix) <sup>3</sup>	TSS/TTA	Vitamin C <sup>4</sup>
Iaçu					
LagedodeDentro	2.8	1.66	14.0	8.5	14.0
FrentedaLagoa	2.7	1.45	10.2	7.0	9.9
AcessoRochoso	2.7	1.80	9.2	5.1	13.2
RuaSantaRosa	2.9	1.10	9.2	8.3	8.6
Vavazinho	3.0	0.89	9.4	10.6	13.3
Cruz das Almas					
SítiodoTercinho	2.9	1.40	10.2	7.3	4.2
EmbrapaSPM	2.7	1.84	9.0	4.9	7.0
Milagres					
DeusDará1	2.8	1.31	12.0	9.2	14.2
DeusDará2	2.6	1.70	10.0	5.9	13.8
LagoadaBebedice1	2.7	1.35	8.0	5.9	15.1
LagoadaBebedice2	2.9	1.59	9.0	5.7	11.0
BaixadasCueranas	2.7	1.64	9.0	5.5	13.0
Amargosa					
Amargosa1	3.0	1.88	10.0	5.3	4.0
Amargosa2	2.5	1.82	11.0	6.0	12.4
Bela Vista	2.9	1.35	13.8	10.2	5.8
Coração de Maria					
Faz. Cordeiro	2.7	1.95	7.2	3.7	5.0
Iraá					
Faz. Juazeiro1	2.8	1.68	9.2	5.5	5.9
Faz. Juazeiro2	2.8	1.83	10.2	5.6	9.3
Santanópolis					
Faz. Lamarão	2.8	1.89	10.2	5.6	5.5
Santa Bárbara					
Cruzeiro	2.4	2.10	11.8	5.6	11.1
Burdão	2.6	1.63	9.6	5.9	10.1
Renovado1	2.7	1.71	9.1	5.3	7.6
Renovado2	2.4	2.10	10.4	5.0	11.3
Tanquinho					
Cangaceiro	2.7	2.30	11.2	4.9	10.3
Primavera	2.6	1.97	11.0	5.6	16.0

<sup>1</sup> Average of five replications. <sup>2</sup> TTA- Total titratable acidity, expressed as % of malic acid. <sup>3</sup> SST- Total soluble solids, expressed as °Brix.

<sup>4</sup> Vitamin C, expressed as mg of ascorbic acid 100 g of pulp<sup>-1</sup>.

## Avaliação de germoplasma de umbu-cajazeira no estado da Bahia

**RESUMO** – A umbu-cajazeira é uma planta arbórea nativa do Nordeste brasileiro, que apresenta boas perspectivas de aproveitamento econômico. Com o objetivo de conhecer melhor a variabilidade existente na espécie, foi feita a identificação de 43 genótipos de umbu-cajazeira em 14 municípios do Estado da Bahia. Frutos destes genótipos foram coletados para análises físicas, químicas e físico-químicas. Todas as características analisadas apresentaram grande variação, havendo, entretanto, predominância entre genótipos de frutos com forma piriforme a ligeiramente piriforme, com peso entre 15 g a 27 g, índice polpa/caroço em torno de 2,0, acidez total titulável entre 1,5% e 2,6%, sólidos solúveis totais entre 9,0° Brix e 14,0° Brix, e vitamina C entre 3,6 e 16,4 mg de ácido ascórbico 100 g polpa<sup>-1</sup>. A presença de sementes variou, entre genótipos, de 5 a 100% de frutos sem sementes.

**Palavras-chave:** *Spondias*, seleção, variabilidade genética, melhoramento vegetal.

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