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Assessment and Physico-Chemical Characterization of Fruits from Different Tucuma Palm Tree Accesses for Keeping Their Preservation in Central Amazonia

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Abstract

The Fruit from the Amazonian tucuma tree (*Astrocaryum aculeatum* Meyer) is almost entirely randomly extracted and thus, it holds a wide genetic variability, which diminishes its evenness besides several characteristics like pleasant flavor and thick pulp so appreciated when it comes to be consumed by humans. This fact is associated to the reproductive system, since it is a cross-pollinating plant. The present work assessed nine tucuma fruit accesses in Manaus, BR-174, Rio Preto da Eva and Vila do Equador, Rorainópolis Township, following the producers' fruit preference indication. Simple correlation analysis indicates lipid content to be independent from the assessed characters, since it correlated to none of them. Therefore, the population formed from the selected accesses (BR 174, Jundiá 1, Manaus 1, Manaus 2), based on flavor, pulp thickness, yield and lipid content, will have a great chance of obtaining more uniform fruits that will please the consumers' taste.

Keywords: tucuma tree, characteristics, pulp and flavor

1. Introduction

The tucumanzeiro of Amazonas (*Astrocaryum aculeatum* Meyer) is a single stem of palm tree, up to 25 m tall and 15-33 cm in diameter and stem covered with black thorns pointed, of 10-15 cm long. The leaf sheaths are also covered of thorns. This plant occurs predominantly in the highlands of the State of Amazonas, Acre, Roraima, Rondonia and parts of Pará, Peru and Colombia. The fruit pulp and seeds can be extracted from different types of edible oils, and can be used in human food supplement and in the manufacture of animal feed. Its economic importance is based mainly on the exploitation of the pulp of the fruit, which can be consumed fresh or in ice creams, juice, liquor and sweet (Silva, 2011). In the Amazon, its greatest potential is in the fruit, where the pulp is cut into chips that are used in the preparation of sandwiches and filling tapioca, typical of the Amazon region, as well as in pizzas and ice cream.

Nutritionally, the tucuma fruit is characterized by containing high vitamin A content and lipid content (10286 µg/100 g), thus becoming a highly energetic fruit, holding 439 kcal per 100 g of its edible portion (Yuyama et al., 2011). The tucumã plant is typically extractive, hardly the cultivation of the species occurs, because the seed finds it difficult to germinate because it is wrapped in a layer of ligneous endocarp and lipid-rich mesocarp that hinders the penetration of water. To speed up the germination one has to let it dry until the kernel (endosperm) comes away from the endocarp, which is then mechanically breached to let the water go through. In nature small rodents such agouti can do this service. This is a predominantly alogama species, its genetic variability is very wide and losing a lot of genetic material of economic interest with the advancement of the development of urban and farming areas. Hence, it becomes highly important to identify and preserve the trees yielding good tasting fruits while still there, starting by the big city area. Generally, the plants are kept around the outdoors of small cottages, and in small farms. Property owners and local merchants (fruit stand owners) are the connoisseurs of good tasting fruits. Therefore tucuma fruits were acquired at fairs, markets and private properties in the states of Amazonas and Roraima so as to perform their physicochemical and nutritional analysis.

2. Material and Methods

Tucuma fruits were initially acquired, according to the indication of merchants and producers, by following what they ranked as the best tasting ones. However, it is difficult to get to the plant itself, since both merchants and producers have not much to to show how to do it and, often they themselves get the fruits through third parties. Thus, what was left was to try and buy a tucuma fruits with the same characteristic in the merchant's stand. The best tasting fruits were used to perform the physicochemical analysis assessing the interesting agronomic and nutritional characteristics and, then, seeds were selected for trying to produce seedlings. We got a total of nine accesses to good tasting tucuma: two in Vila do Jundiá, Rorainópolis Township, in the state of Roraima; seven in the state of Amazonas two of them at the market in the Rio Preto da Eva, four at the fair in Manaus and one at a private property on BR-174 km 8 in the outskirts of Manaus, plants with high oil content seeded at over twelve years. Tucuma fruit pulp (mesocarp) should be soft so as to be consumed, thus the fruits bearing a hard pulp are to be wrapped in plastic bags until it becomes soft. Fruits in a cluster hardly present any variations.

Fifteen fruits per access were separated to undergo physical analysis. The experimental design comprised nine treatments with three replicates, being each replicate constituted by five fruits. Fruits had their length and diameter measured and, following the treatment for ripening the epicarp (peel) peeled and then the mesocarp (pulp) removed, reaching the pyrene (ligneous endocarp wrapping the seed). Sensory analysis was performed with the participation of twenty volunteers, from which the analyzes of the results were made. From each portion we determined the weight of the fruit and the thickness of the mesocarp and, in the foods physicochemical laboratory at INPA, the lipid analysis was performed. The ether extract fraction was determined by Soxhlet extractor intermittently using petroleum ether as solvent pa (AOAC, 1995). Data were statistically analyzed using analysis of variance by F test and the means by Tukey test at 5% probability.

3. Results and Discussion

The tucuma fruit showed a wide variability on weight 97.4 g and 37.3 g; whole pulp 27.3 g and 4.4 g; peel 14.9 g and 5.3 g and seed size 51.3 g and 22.7 g (Table 1), corroborating Silva (2011). The larger fruit, at Jundiá 1 access, was longer, wider, had a heavier pulp due to its larger thickness, and showed to be suitable for being selected to be consumed. Conversely to what happened with the fruit at Jundiá 2 access that showed to be lighter, shorter, not as wide and to hold a thinner pulp. Thus, R. Preto 2, Manaus 1, Manaus 2 and BR 174 accesses stood out on account of presenting fruits with over 3.5 mm thick pulps. The fruit from Manaus 2 presented the second highest weight, equalizing with Manaus 1 in pulp weight, but with a heavier peel, thus showing to be more suitable than the one from Manaus 1 for food production purposes (Table 1). One notes the tucuma fruits not to be even-shaped, at Jundiá 1, Jundiá 2, R. Preto 2, Manaus 1, Manaus 3 and Manaus 4, they are oval-shaped (fruit longer than wider) and Rio Preto 1, Manaus 2 and BR 174 they are almost round or slightly flattened (Table 1).

Table 1. Data on the average weights of the pulp, peel, seed and fruit, in g/fruit; length, dimeter and pulp thickness, in mm, of fruits purchased at the market in Vila do Jundiá in Rorainópolis, RR; market in Rio Preto da Eva; Coroado fair and a rural property ono BR174, in Manaus, Amazonas, in 2014

Accesses	Fruit	Pulp	Peel	Seed	Fruit length	Fruit Diameter	Pulp Thickness
	----------g/fruit----------				----------mm----------		
Jundiá 1	97.4 a	27.3 a	14.9 a	51.3 a	56.1 a	51.8 a	4.2 a
Jundiá 2	37.3 g	4.4 e	7.2 de	22.7 e	40.7 d	38.1 e	2.4 b
R. Preto1	47.0 ef	7.7 de	7.4 de	32.7 c	41.9 cd	42.8 cd	2.3 b
R. Preto 2	57.3 d	11.8 c	8.9 bcd	27.9 cd	44.3 c	40.9 de	3.9 a
Manaus 1	68.3 c	18.4 b	11.1 b	38.9 b	49.4 b	45.8 b	3.5 a
Manaus 2	78.3 b	18.0 b	13.4 a	46.2 a	49.6 b	51.8 a	3,5 a
Manaus 3	49.9 e	10.1 cd	8.6 cd	29.1 cd	49.0 b	41.8 cd	2.3 b
Manaus 4	40.6 fg	8.1 d	5.3 e	26.2 de	41.5 cd	38.6 e	2.4 b
BR 174	53.0 de	12.5 c	10.5 bc	28.2 cd	41.8 cd	43.9 bc	3.5 a
C.V. (%)	4.8	11.2	9.5	6.5	3.1	2.7	11.3

Note. *Averages followed by the same letter, in vertical, do not differ among themselves, by the Tukey test ($p < 0.05$).

Fifty-two (52) to 70% of the fruit represents the seed and 11 to 28% the edible portion (Table 2), corroborating core 61% and pulp 17.8 % averages described by Yuyama et al. (2005), yet, fruit size exerts no influence on seed size, since they are independent characteristics, according to the simple correlation analysis (r = -0.481, Table 3).

Table2. Data, expressed in percentages, on seed, pulp yields, lipids content and flavor of the tucuma fruits acquired at the market in Vila do Jundiá in Rorainópolis, RR; market in Rio Preto da Eva; Coroado fair and rural property on BR174, in Manaus, Amazonas, 2014

Accesses	Seed Yield	Pulp Yield	Lipids content	Flavor
	----------(%)----------			
Jundiá 1	52.66	28.08	51.08	Very good
Jundiá 2	60.85	11.79	61.80	Regular
Rio Preto1	69.57	16.38	58.90	Good
Rio Preto 2	48.69	20.59	57.52	Good
Manaus 1	56.95	26.93	54.42	Good
Manaus 2	59.00	22.98	65.21	Good
Manaus 3	58.31	20.24	30.24	Regular
Manaus 4	64.67	19.95	44.44	Good
BR 174	53.20	23.58	67.25	Very good

The present work showed the lipid content to be a lor higher than the one reported in literature (33.0 to 37.5%, Yuyama et al., 2005), only in the Manaus 3 access it was lower with 30.24%, in the others it was higher from 44.44% (Manaus 4) to 67.25% (BR 174). It also surpasses that of *Astrocaryum vulgare* of Pará 40.49 ± 0.54% (Ferreira et al., 2008). The simple correlation analysis showed there to be no correlation between Lipid content and the other analyzed characteristics, showing every plant to hold its individual and private Lipid content (Table 3), therefore tucumã flavors do not depend on the Lipid contents, as it happens with the fruits from the peach palm trees pupunheiras, which by presenting an above 20% oil content, happen to be the ones preferred by the Amazonian population. Jundiá 1 and BR 174 accesses were the preferred ones, the pulp tasting test was ranked as very good, but in spite of each person having his or her own preference, these two accesses showed to be everyone's preferred (Table 2).

Table 3. Simple correlation analysis

	FW (g)	PW (g)	FP (g)	SW (g)	FL (mm)	FD (mm)	PT (mm)	SP (%)	PP (%)
PW (g)	0.980**								
FP (g)	0.948**	0.920**							
SW (g)	0.954**	0.919**	0.889**						
FL (mm)	0.903**	0.899**	0.831**	0.870**					
FD (mm)	0.936**	0.894**	0.946**	0.964**	0.811**				
PT (mm)	0.808**	0.816**	0.802**	0.629*	0.584 ns	0.670*			
SP (%)	-0.481 ns	-0.510 ns	-0.542 ns	-0.203	-0.408*	-0.285 ns	-0.812**		
PP (%)	0.808**	0.893**	0.755**	0.728*	0.748**	0.733**	0.756**	-0.535 ns	
LC (%)	0.105 ns	0.043 ns	0.254 ns	0.098 ns	-0.287 ns	0.226 ns	0.370 ns	-0.108 ns	-0.065 ns

Note. ns: not significant at 5% probability, *: significant at 5% probability, **: significant at 1% probability. FW-fruit weight, PW: pulp weight, FP: fruit peel, SW: seed weight, FL: fruit length, FD: fruit diameter, PT: pulp thickness, SP: seed percentage, PP: pulp percentage and LC Lipids content.

Pulp yield was higher at the Jundiá 1 access with 28.08% and lower at Jundiá 2 access with 11.79% (Table 2).

Jundiá 1 access holds some agronomical characteristics important in the Fruit Improvement Program, such as, big-sized fruit, thick pulp and 51% Lipids content. Rio Preto 2, Manaus 1, Manaus 2 and BR 174 accesses, also present interesting features, in pulp yield, fruit size and Lipids content. Since tucuma plant Como, according to Bacelar-Lima and Pessoni (2000) is cross-pollinating, and Ramos (2008) estimated its crossing rate to be 97.8%, with 2.2% of it being from self-pollinated seedlings. Hence the cultivation with these four accesses being analyzed in locus becomes quite interesting.

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