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Biometric Analysis of Fruits of Muruci (*Byrsonima crassifolia* (L.) Rich.)

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Abstract: The objective of this research was to study the physical characterization of fruit and endocarp of muruci from the region of Capitao Poco-PA. The fruits which are widely used *in natura* consumption were collected in a deforested area of Amazon forest and led to the Multifunctional Laboratory of Federal Rural University of Amazonia, Campus of Capitao Poco. About 600 fruits were sampled and fresh weight (MMF), length and diameter of fruits and endocarps beyond the pulp yield were evaluated. The MMF of the fruits ranged from 0.63-3.83 g and 30.1% of fruit showed MMF between 1.27 and 1.59 g. The MMF of the endocarps ranged from 0.10-0.48 g while 21.7% of the endocarps had MMF between 0.22 and 0.26 g. MMF mean, length and diameter were 1.52 g, 11.49 and 13.35 mm, respectively. As for the endocarps it was respectively, 0.26 g, 8.39 and 7.16 mm. The average MMF was 1.26 g fruit^{-1}. The correlation coefficient between the fruit MMF and the pulp MMF was 0.999, therefore the MMF of the fruit is directly proportional to the amount of pulp. The wide variation in measures of MMF and fruit size may be related to the high variability of muruci plants found in the collection area.

Key words: Amazon, physical characterization, Capitao Poco, furits, plants, Brazil

INTRODUCTION

The Brazilian natural heritage expressed by continental extension, endemism and diversity of biological species and its genetic heritage as well as its variety of ecosystem biomes displays wide global relevance (Assuncao and Felfili, 2004).

The murucizeiro (*Byrsonima crassifolia* (L.) Rich.) is a specie which produces fruit, belonging to Malpighiacea family with a probable center of origin and dispersal in the Amazon (De Carvalho and do Nascimento, 2008). It presents a wide geographic distribution in Brazilian territory, occurring spontaneously, more frequently in the North, Northeast and Midwest. The fruit of murucizeiro when ripe has a yellowish color with a strong odor, similar to rancid cheese (Alves and Franco, 2003). The sale is limited to street fairs and local markets and its pulp is fleshy and soft and it can be consumed raw or in the form of juices, jams, ice creams and liqueurs.

Studies on the biometry of fruits and seeds constitute an important tool for identifying genetic variability within populations of the same species and the relations between such variability and environmental factors and thereby, they may be used in breeding programs. The analysis of the yield of fruit pulp indicates value both for consumption and fresh fruit as for agro-industrial use (De Carvalho *et al*., 2003). The classification of seeds is made by size and weight to standardize the emergence of seedlings and to obtain plants of similar size or with greater force (Carvalho and Nakagawa, 2000). Assuming the existence of genetic variability available to be explored in breeding programs for fruit traits, the aim of this study was to obtain information as well as physical characteristics of fruit and endocarp to determine size, fresh weight and yield of the pulp of muruci in the region of Capitao Poco in Para.

MATERIALS AND METHODS

The fruits were obtained from a deforested area of the Amazon forest where murucizeiros were spread naturally in approximately 2.0 ha, located in the community of Nova Colonia, in the municipality of Capitao Poco, PA (at 01° 41'17" South latitude and 047°05'34" West longitude).

The regional climate according to Koppen is the type Am with annual precipitation around 2.500 mm with a short dry season between September and November (monthly rainfall around 60 mm), average temperature of 26°C and relative humidity between 75 and 89% in months with lower precipitation and greater, respectively (Schwart, 2007).

The fruits used were from 20 trees that have suffered natural abscission in February 2010 which were collected on the day, they dropped naturally from the plant. To obtain a representative sample of the population, trees were chosen traversing the studied area throughout its

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length (De Moraes *et al*., 1999). Then the fruits were placed in polyethylene bags and taken to the Multipurpose Laboratory of the Federal Rural University of the Amazon, Campus of Capitao Poco. After collection, they were maintained for 2 days in a natural environment for completing maturation so, the pulpy portion (mesocarp) could be presented with soft consistency. When the fruits reached that point, the pulp was removed manually and the kernels were washed in running water until they were completely free of waste pulp. Sub-sequently, the drying procedure was started by drying their surface with a study towel and than they were left to dry for 48 h under ambient conditions. Thereafter, evaluations were made.

In the laboratory, 600 fruits were selected by separating those visually healthy, entire and without deformation for biometric evaluations. The length and equatorial diameter of fruit and endocarp were determined with the aid of a digital caliper in 600 fruits and 600 endocarps.

In this study (Pedron *et al*., 2004), it was decided to use the term endocarp instead of pit (endocarp+seed). After measuring the size and fresh weight (MMF) of the fruit, it was washed by hand to assess the MMF and the size of the endocarp as well as to measure the pulp MMF per fruit.

The extraction yield of pulp was determined for the total sample, sub-tracting the MMF of the whole fruit endocarp according to Lima *et al*. (2002). To measure the MMF of fruit and endocarp, it was used an accurate analytical balance.

The biometric data of fruit and endocarp was analyzed by frequency distribution. The correlation coefficient nonparametric Spearman (rs) was calculated and its level of significance analyzed (p) between variables by testing the distribution of unilateral student at 5% probability.

RESULTS AND DISCUSSION

Table 1 and Fig. 1 show the biometric data of the fruits of *B. crassifolia*. The results allow us to observe that the fruits and endocarps studied were represented by two classes of size with fruit and endocarp of smaller and larger size with less frequently separated by fruit and endocarp of intermediate sizes with higher frequency (Fig. 1). The same was observed for endocarps MMF (Fig. 1). As for the fruits MMF, those with lower MMF showed a higher frequency (Fig. 1a-g).

It was observed a larger amount of fruits with MMF between 1.27 and 1.59 g (30.1%) (Fig. 1a). In this study, it was found fruits with MMF between 0.63 and 3.83 g (Fig. 1a and Table 1). This difference in fruit MMF may be associated with phenotypic differences determined by environmental variations. The fruits had the most frequent pulp MMF between 1.05 and 1.34 g (31.3%) (Fig. 1b). The average pulp MMF was 1.26 g^{-1} fruit with values between 0.48 and 3.34 g (Table 1).

Table 1: Physical characteristics of fruit, endocarp and pulp of *Byrsonima crassifolia* (L.) Rich.

Charateristics	Maximum	Minimum	CV (%)	Mean±SD
Fruit				
Fresh weight (g)	3.83	0.63	30.71	1.52±0.47
Length (mL)	16.70	8.00	11.36	11.49±1.30
Diameter (mL)	19.10	9.60	10.82	13.35±1.44
Endocarp				
Fresh weight (g)	0.48	0.10	26.52	0.26±0.07
Length (mL)	11.40	5.70	9.99	8.39±0.84
Diameter (mL)	11.00	4.80	10.99	7.16±0.79
Pulp				
Fresh weight (g)	3.34	0.48	32.79	1.26±0.41

Table 2: Spearman correlation (rs) for the biometric variables of the fruit and endocarps of *Byrsonima crassifolia* (L.) Rich.

Comparisons	RS
Fruit MMF x length/diameter of the fruit	0.975*/ 0.991*
Endocarp MMF x length/diameter of the endocarp	0.989*(1)
Fruit MMF x endocarp MMF	0.989*
Fruit length/diameter x endocarp length/diameter	0.990*(1)
Fruit MMF x pulp MMF	0.999*
Fruit length/diameter x pulp length/diameter	0.970*/0.988

*Significant at 5% of probability level (1). Average value of the combinations (all significant)

Most fruits presented length between 10.61 and 11.48 mm (25.5%) (Fig. 1c) and 12.45 mm and diameter of 13.40 mm (26.8%) (Fig. 1d). In the present study, it was found fruits with a diameter between 9.6 and 19.1 mm (Table 1). The biggest difference found in this study may be related to climatic and edaphic influences. Even belonging to a single specie, the plants are subjected to variations of temperature, day length, rainfall and other variables that ultimately emphasize certain aspects on their genetic composition therefore, the environment may be suitable for the expression of certain characteristics that are not manifested elsewhere (Botezelli *et al*., 2000). Concerning the biometrics of endocarps, it was observed that MMF, length and diameter were more frequent between 0.22 and 0.26 g, 7.98 and 8.55 mm and 6.66 and 7.28 mm, respectively (Fig. 1).

The correlation (Table 2) between the fruit MMF and the pulp MMF was 0.999 therefore, the MMF of the fruit is directly proportional the amount of pulp as the pulp contributes on average 82.89% of total fruit MMF showing a good yield of pulp. It was also noted that large fruit have a higher amount (MMF) of pulp (rs = 0.988, $p<0.05$).

There was also a positive correlation between fruit MMF and fruit size (rs = 0.975 and 0.991, $p<0.05$). Pedron *et al*. (2004) analyzing biometric parameters of pindo fruits also observed the existence of high

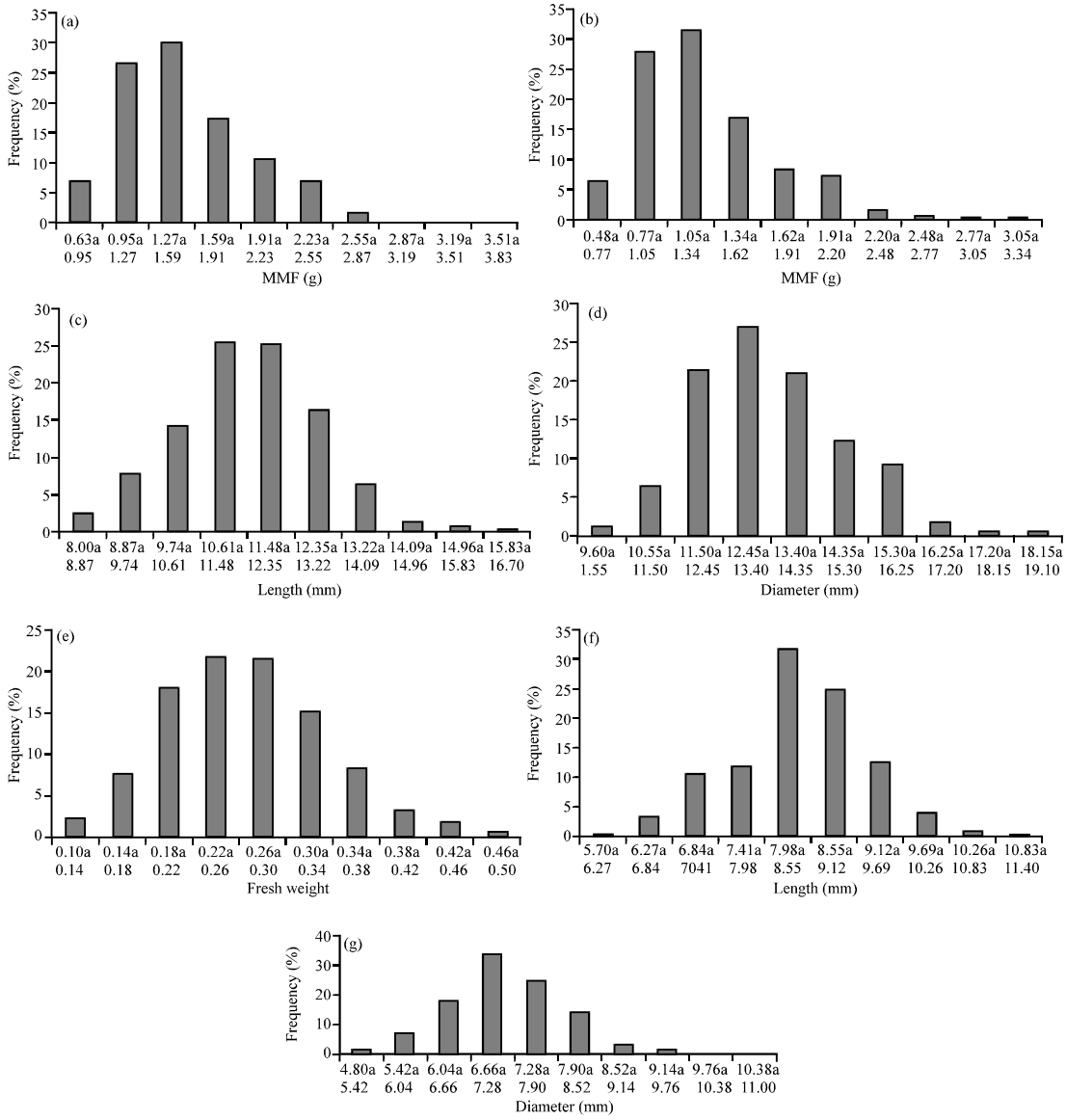

Fig. 1: Fresh weight (MMF) of fruit: a) pulp MMF; b) length; c) diameter; d) fresh weight (MMF) of endocarp; e) length; f) diameter of the endocarps and g) of *Byrsonima crassifolia* (L.) Rich.

correlation, linear and positive relation between the fruit MMF and fruit size. In the present study, larger fruits presented higher endocarp (r_s = 0.990, $p>0.05$). The variable that better explained the fruit MMF was the pulp MMF (r_s = 0.999, $p<0.05$). The endocarp MMF showed a significant positive correlation with fruit size and MMF (r_s = 0.989, $p<0.05$). We also observed that calculated coefficient of variation was higher in measures of MMF of fruits, endocarps and pulp. The measures of fruit size and endocarp size showed less variation (Table 1). Moreover, the variation found in the dimensions of the fruits of *Byrsonima crassifolia* should not be promoted only by environmental factors but may also represent an indication of high genetic variability population. However to confirm and discuss these possibilities, it is necessary to study the genetic structure of *Byrsonima crassifolia.*

CONCLUSION

This study verified that the weight increase of pulp is linked to biometric parameters (MMF, length and diameter) of the fruit because there is a positive correlation between pulp MMF and MMF, length and

diameter of the fruit. Thus, large fruits have higher MMF due to the greater amount of pulp as well as higher endocarps. The variation in the measurement of fresh weight and fruit size indicates potential for selection of species and the establishment of germplasm bank of the population studied.

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