REVISTA BRASILEIRA DE FRUTICULTURA
Published by the Brazilian Society of Fruit Crops
ISSN 0100-2945

Harvest And Postharvest - Scientific Communication - Edited by: Márcio Eduardo Canto Pereira

Proposal of classes for umbu commercialization

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Abstract: The commercial classification of fruits organizes commercialization and promotes compliance. The aim was to propose classes for umbu fruits based on fresh mass. A total of 4,140 fruits from four harvests of the BRS-68 umbu cultivar (EPAMIG-C01) with average mass of 87.64 g ± 13.99 were used, individually weighed on analytical precision scale, and, the mean and standard deviation of 3,717 fruits within the mean confidence interval were considered for class stratification. Five size classes were determined, medium (≥ 50 and < 65 g), large (≥ 65 and < 75 g), giant (≥ 75 and < 100 g), extra (≥ 100 and < 110 g) and premium (≥ 110 g), however, three classes are recommended, large (≥ 50 and < 75 g), giant (≥ 75 and < 100 g) and premium (≥ 100 g), due to their easy adoption and use.

Index terms: *Spondias tuberosa* Arruda, fresh mass, homogeneity, valorization.

Proposta de classes para comercialização de umbu

Resumo: A classificação comercial de frutos organiza a comercialização, valorizando em conformidade. Objetivou-se propor classes para umbu baseadas na massa fresca. Foram utilizados 4.140 frutos de quatro safras da cultivar BRS-68 (EPAMIG-C01) com massa média 87,64g ± 13,99, pesados individualmente em balança analítica de precisão e, considerados para estratificação das classes, a média e o desvio-padrão de 3.717 frutos dentro do intervalo de confiança da média. Determinaram-se cinco classes de tamanho: médio (≥50 e <65g), grande (≥65 e <75g), gigante (≥75 e <100g), extra (≥100 e <110g) e premium (≥110g), porém recomendam-se três classes: grande (≥50 e <75g), gigante (≥75 e <100g) e premium (≥100g), pela facilidade de adoção e uso.

Termos para Indexação: *Spondias tuberosa* Arruda; massa fresca; homogeneidade; valorização.

Rev. Bras. Frutic., v.46, e-516 DOI: *https://dx.doi.org/10.1590/0100-29452024516*
Received 20 Apr, 2023 ● Accepted 11 Jan, 2024 ● Published Mar/Apr, 2024. Jaboticabal - SP - Brazil.

The commercialization of classified fruits allows product valorization and fair pricing. Although comprehensive, the current commercial classification does not include some fruits obtained through extractivism, such as umbu, the fruit from the umbu plant (*Spondias tuberosa* Arruda), a fruit plant native to the Brazilian Caatinga biome. The harvest is concentrated between December and March in the Northern state of Minas Gerais and Southwestern state of Bahia, with some variation in other regions of the semiarid region due to the rainy season, and its area with commercial cultivation is expanding.

Umbu is manually harvested, consumed fresh or processed. Commercialization takes place by volume, priced by kilo or dozen, in bulk, packed in nylon or raffia bags, boxes or in trays with variable number of fruits. The fruit is sold on the side of highways, in markets, fairs, by street vendors and in rural communities to middlemen (SATURNINO; SOUZA, 2019), who sell them in large centers at CEASAS and retail.

In 2021, Brazilian production was 12,771 tons, totaling R$ 17,608.00 (IBGE, 2023). However, the absence of classification standards underestimates the price paid for the fruit, as it disregards size, fresh mass and color. Differences occur depending on genotype or maturation stage (SARAIVA et al., 2022). Menezes et al. (2017) found mass of green, almost ripe and ripe umbu fruits of 14.45 g, 12.46 g and 10.74 g, respectively. Donato et al. (2019) reported average fresh mass ranging from 9.24 g to 76.14 g. Santos et al. (2020) consider large fruits those with mass between 50 and 70 g and giant fruits, those greater than 70 g, while Neves (2010) refers to giant fruits those with average mass above 50 g.

EPAMIG-C01 umbu accession, currently called cultivar BRS-68 (DONATO et al., 2022a) is the most widespread giant-type umbu, originating from Lontra, MG. Although the classification norms in force for fruits consider diameter, defects, skin and pulp color, etc., the definition of classes, based on the fresh mass of umbu as the first approximation, constitutes an advance for its commercialization. The aim of this work was to propose fruit classes based on the fresh mass of the BRS-68 umbu cultivar (EPAMIG-C01).

Database containing the individual fresh mass of 4,130 BRS-68 umbu fruits (EPAMIG-C01), originating from Lontra, MG (DONATO et al., 2019; 2022a; 2022b) collected from 16 umbu plants in four seasons (2016-2017; 2020-2021; 2021-2022 and 2022-2023) was used. Twenty fruits per plant were sampled from 03 plants in the 2016-2017 and 2020-2021 seasons, and from 12 plants in the 2021-2022 and 2022-2023 seasons located in the Accession Collection of the IF Baiano Campus Guanambi, at coordinates 14°17 '38.50''S, 42°41'35.94''W and 546 m a.s.l., as well as all fruits from 2020-2021, 2021-2022 and 2022-2023 harvests from an urban plant located in the municipality of Guanambi, BA, at coordinates 14°13'03''S, 42°46'10''W and 535 m a.s.l. (DONATO et al., 2022b).

Fruits evaluated in this study came from different harvests and plants, ensuring that the evaluated characteristic was, in fact, representative of the BRS-68 umbu cultivar (EPAMIG-C01). Fruits were manually harvested before the natural fall at maturation stage popularly known as 'swollen', which is characterized by fruits with green peel and beginning of pulp softening (FREITAS; OLIVEIRA, 2021). After harvest, fruits were weighed on a digital scale, one by one, with fresh mass values recorded in grams. As it is a native species of the Brazilian flora, the activity is registered in SISGEN under number A97F56E.

The individual masses of the 4,130 fruits were sorted in descending order and position measurements were calculated: mean $\bar{x}$ = 87.64 g; median = 88.00 g; and mode = 87.00 g; and dispersion measures: standard

deviation $S\bar{x}$ = 13.99; coefficient of variation CV = 15.97%; variance = 195.77; highest value = 140 g; smallest value = 48 g; and amplitude = 92g; confidence intervals $CI = \bar{x} \pm t\alpha.S\bar{x}$ were also estimated; where $t\alpha$, bilateral t value at 10% probability, with $n\text{-}1$ degrees of freedom, with CI values ranging from 64.62 g to 110.66 g.

For the stratification of size classes, the mean and standard deviation of 3,717 fruits within the mean confidence interval were considered using the equation: FS = $\bar{x} \pm kS\bar{x}$, where $\bar{x}$ = mean fresh mass; $S\bar{x}$ = standard deviation of the mean; and k = correction factor for class adjustment, avoiding very wide intervals, whose adopted value was k = 1.0, since CV was below 20%. Thus, five size classes were adjusted for umbu mass above 50 g, which lower limit was established based on the conventional description for large and giant umbu fruits (Donato et al., 2019; Santos et al., 2020): medium ≥ 50 and < ($\bar{x}$–2k$S\bar{x}$); large ≥ ($\bar{x}$–2k$S\bar{x}$) and < ($\bar{x}$–k$S\bar{x}$); giant ≥ ($\bar{x}$–k$S\bar{x}$) and < ($\bar{x}$–k$S\bar{x}$); extra ≥ ($\bar{x}$+k$S\bar{x}$) and < ($\bar{x}$+2k$S\bar{x}$) and premium ≥ ($\bar{x}$+2k$S\bar{x}$). To facilitate the adoption of the commercialization classification, three classes were adjusted: large ≥ 50 and < ($\bar{x}$–k$S\bar{x}$); giant ≥ ($\bar{x}$–k$S\bar{x}$) and < ($\bar{x}$+k$S\bar{x}$); and premium ≥ ($\bar{x}$+k$S\bar{x}$).

In the universe of 4,130 umbu fruits, the individual fresh mass ranged from 48 g to 140 g and the coefficient of variation (CV) was 15.97%, and, after restricting the population to 3,717 fruits limited by the mean confidence interval (CI), mass variation ranged from 64.62 g to 110.66 g with CV of 12.72% (Table 1). Data from harvests, plants and different areas illustrate the low variability of this trait and ensure data robustness, as the fruit mass is highly repeatable and heritable, requiring only one year of evaluation for the reliable *in situ* or *ex situ* characterization of individuals with accuracy of 90%, while production requires four years (SANTOS, 1999), thus showing greater environmental and management influence for this trait.

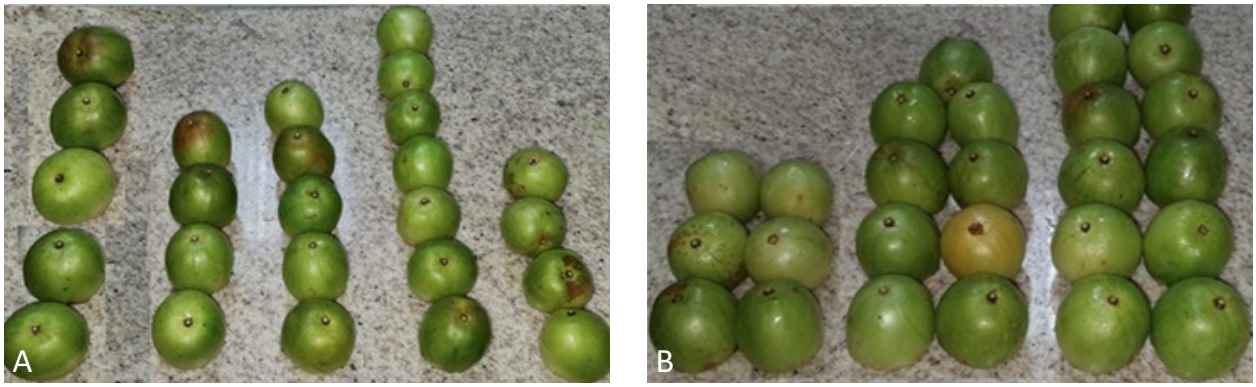
Table 1. Proposal of size classes for umbu commercialization with mass greater than or equal to 50 g based on the BRS-68 umbu cultivar (EPAMIG-C01).

Five classes			Three classes		
Classes	Classification	Fresh mass variation (g)	Classes	Classification	Fresh mass variation (g)
1	Medium	≥ 50 and < 65	1	Large	≥ 50 and < 75
2	Large	≥ 65 and < 75	2	Giant	≥ 75 and < 100
3	Giant	≥ 75 and < 100	3	Premium	≥ 100
4	Extra	≥ 100 and < 110			
5	Premium	≥ 110		Class limits based on $\bar{x}\pm S\bar{x}$ (g)	
Mean ($\bar{x}$)	87.51	CV (%)	12.72	($\bar{x}$ – 2k$S\bar{x}$)	65.25
Median	88.00	Variance	123.87	($\bar{x}$ – k$S\bar{x}$)	76.38
Mode	87.00	CI	64.62-110.66	($\bar{x}$ + k$S\bar{x}$)	98.64
Standard-deviation ($S\bar{x}$)	11.13	CV (%)	12.72	($\bar{x}$ +2k$S\bar{x}$)	109.77

CI = confidence interval of the original population mean used to restrict the population for stratification of size classes; mean, median, mode, standard deviation, coefficient of variation and variance calculated for n = 3,717 fruits; original sample size n = 4,130 fruits; sample size in the restricted population within the mean confidence interval n = 3,717 fruits.

Despite the exact values calculated for class limits based on the $\bar{x}$ $S\bar{x}$ of 65.25 g, 76.38 g, 98.64 g and 109.79 g (Table 1), to facilitate understanding and adoption by users, rounded practical limits were adopted, corresponding, respectively, to 65 g, 75 g, 100 g and 110 g. The proposed classes (Table 1, Figure 1) are permeating the intervals that are conventionally called in literature as large and giant umbu fruits (NEVES, 2010; DONATO et al., 2019; SANTOS et al., 2020). This class proposal constitutes a first essen-

tial approximation to guide the commercialization of umbu fruits with mass greater than 50 g. However, it demands further refinement for commercial classification, regarding the definition of subclasses based on skin color and maturation stages, categories that include mild and severe skin defects and the description of the different accessions.



≥ 110	≥ 100 and < 110	≥ 75 and < 100	≥ 65 and < 75	≥50 and < 65	≥ 50 and < 75	≥ 75 and < 100	≥ 100
Premium	Extra	Giant	large	Medium	Large	Giant	Premium

Figure 1 - Representation of the proposal of size classes for umbu commercialization with mass greater than 50 g based on the mass of fruits from BRS-68 umbu cultivar (EPAMIG-C01). Five classes (A); three classes (B).
Photos: Sérgio Luiz Rodrigues Donato

Five size classes are proposed for umbu commercialization with mass greater than or equal to 50 g, based on fruits from the BRS-68 umbu cultivar (EPAMIG-C01), medium (≥ 50 and < 65 g), large (≥ 65 and < 75 g), giant (≥ 75 and < 100 g), extra (≥ 100 and < 110 g) and premium (≥ 110 g). To facilitate adoption by consumers, three classes are suggested, large (≥ 50 and < 75 g), giant (≥ 75 and < 100 g) and premium (≥ 100 g).

Acknowledgments

To the National Council for Scientific and Technological Development (CNPq).

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