REVISTA CONTRIBUCIONES A LAS CIENCIAS SOCIALES

Postharvest of acerola fruits grown in a semi-arid region: characteristics and levels of bioactive polyphenols

Pós-colheita de frutos de acerola cultivados em uma região semi-árida: características e teores de polifenóis bioativos

Poscosecha de la acerola cultivada en una región semiárida: características y contenido en polifenoles bioactivos

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ABSTRACT
The objective of this study was to evaluate the performance of acerola genotypes regarding the postharvest quality of fruits of the genotypes BRS 366 Jaburu, Clone 09, Clone 13, Clone 14, Junko, and Sertaneja, cultivated in southwestern Piauiense, northeastern Brazil. A randomized block design (BCT) was used, with treatments consisting of six genotypes, three repetitions, and three plants per plot. Productivity, fruit mass, fruit length, fruit diameter, color, juice yield, anthocyanins and flavonoids, carotenoids, pH, titratable acidity, and ascorbic acid were evaluated. The results show a high productive potential of Clone 13. However, the genotype BRS 366 Jaburu stands out regarding the physical characteristics of the fruit, providing a better balance in the titratable acidity, good contents of total polyphenols, and high amount of vitamin C allied to the juice yield, which is required for acerola fruits. Thus, BRS 366 Jaburu shows promise for cultivation in the edaphoclimatic conditions of the Sudoeste Piauiense region.

Keywords: *Malpighia emarginata* D.C., BRS 366 Jaburu, superfruit, vitamin C.

RESUMO
O objetivo deste trabalho foi avaliar o desempenho de genótipos de acerola quanto à qualidade pós-colheita de frutos dos genótipos BRS 366 Jaburu, Clone 09, Clone 13, Clone 14, Junko e Sertaneja, cultivados no sudoeste piauiense, Nordeste do Brasil. Utilizou-se o delineamento em blocos casualizados (DBC), com tratamentos constituídos por seis genótipos, três repetições e três plantas por parcela. Foram avaliados a produtividade, massa do fruto, comprimento do fruto, diâmetro do fruto, cor, rendimento de suco, antocianinas e flavonóides, carotenóides, pH, acidez titulável e ácido ascórbico. Os resultados mostram um alto potencial produtivo do Clone 13. No entanto, o genótipo BRS 366 Jaburu destaca-se quanto às características físicas do fruto, proporcionando melhor equilíbrio na acidez titulável, bons teores de polifenóis totais e elevada quantidade de vitamina C aliada ao rendimento de suco, o que é exigido para frutos de acerola. Assim, a BRS 366 Jaburu mostra-se promissora para o cultivo nas condições edafoclimáticas da região Sudoeste Piauiense.

Palavras-chave: *Malpighia emarginata* D.C., BRS 366 Jaburu, superfruta, vitamina C.

RESUMEN
El objetivo de este estudio fue evaluar el desempeño de genotipos de acerola en términos de la calidad poscosecha de los frutos de los genotipos BRS 366 Jaburu, Clon 09, Clon 13, Clon 14, Junko y Sertaneja, cultivados en el sudoeste del estado de Piauí, en el nordeste de Brasil. Se

utilizó un diseño de bloques al azar (RBL), con tratamientos compuestos por seis genotipos, tres repeticiones y tres plantas por parcela. Se evaluaron el rendimiento, la masa del fruto, la longitud del fruto, el diámetro del fruto, el color, el rendimiento en zumo, los antocianos y flavonoides, los carotenoides, el pH, la acidez titulable y el ácido ascórbico. Los resultados muestran un elevado potencial de producción para el clon 13. Sin embargo, el genotipo BRS 366 Jaburu destaca en cuanto a las características físicas del fruto, proporcionando un mejor equilibrio en acidez titulable, buenos niveles de polifenoles totales y una elevada cantidad de vitamina C combinada con el rendimiento en zumo, que es lo que se requiere para el fruto de acerola. BRS 366 Jaburu es, por lo tanto, prometedor para su cultivo en las condiciones edafoclimáticas de la región suroeste de Piauí.

Palabras clave: *Malpighia emarginata* D.C., BRS 366 Jaburu, superfruta, vitamina C.

1 INTRODUCTION

The acerola (*Malpighia emarginata* D.C.), is a fruit whose fruits have excellent nutritional characteristics, highlighting them as a superfruit and popularizing its consumption in several regions of the world. Its fruits are characterized by a high content of bioactive compounds, polyphenols, carotenoids, flavonoids, anthocyanins, and vitamin C, making it particularly important for its ability to reduce oxidative stress in the cells of the human body, protecting the body from various diseases and strengthening the immune system (Nowak et al., 2018).

Vitamin C, in particular, is important for intake in nutritional terms. Doctors, for the most part, consider high doses of vitamin C to be a powerful antiviral, ranked as a functional immunizer for different types of flu strains. Throughout history, vitamin C has been effective as a way to strengthen the immune system, possibly mitigating the effects of symptoms such as from diseases such as the coronavirus (COVID-19), a pandemic experienced today (Orthomolecular Medicine News Service, 2020).

The amount of these compounds, as well as characteristics related to flavor, acidity, fruit size, and pulp yield, depends on the genotype, environmental conditions, and harvest point of the fruit (Horta et al., 2016).

The need of the market dictates the process of genetic improvement of this culture, which, for presenting nutraceutical characteristics of high value, is destined to be consumed in nature and processed for food and pharmaceutical products. The creation of new genotypes allows the production of fruits with high-quality standards that meet the diverse demands of the consumer.

The high genetic standard coming from breeding programs, which is reflected in orchards mostly of clonal origin, added to places with irrigation possibilities, high solar irradiation indexes, moderate rainfall, and soils with good drainage allow the optimal development of this crop, with high-quality fruits (De Paiva et al., 2018).

The study of cultivars in producing regions or with cultivation potential and of genotypes in the process of being studied for market launch is what makes it possible to validate the characteristics related to the fruit, from the development phase to its final quality, analyzing the quality of the genetic characteristics associated with the edaphoclimatic pattern of the cultivation location and attesting to the quality of the final product at harvest time.

The last agricultural frontier, located in the south of Piauí, a state encompassed by the MATOPIBA region (Maranhão, Tocantins, Piauí, and Bahia), is based on the trade of seeds and grains, with a growing area and modernization of cultivation practices, including the renovation of roads for the flow of production.

Such aspects of this agricultural sector have aroused the interest of producers to diversify into other segments, especially fruit farming, a dynamic sector that represented a gain of 33 billion for the national agribusiness economy in 2017 (MAPA, 2018). With favorable conditions for agriculture, flat and extensive areas, soils with high productive potential, water availability and favorable climate, and high sun intensity, the region shows promise (PEREIRA et al., 2018).

The objective of this study was to evaluate the postharvest quality of acerola BRS 366 Jaburu, Clone 09, Clone 13, Clone 14, Junko, and Sertaneja cultivated in southwestern Piauiense, northeastern Brazil.

2 MATERIAL AND METHODS

2.1 DESCRIPTION OF THE EXPERIMENTAL AREA

The study was conducted in 2019 in the experimental field of the Study Group in Fruit Culture (FRUTAGRO) at the Fazenda Escola in the municipality of Alvorada do Gurgueia, PI, Brazil, located at 08° 22'24.89 S, and 43° 51'11.89" W, at an altitude of 231 meters above the sea. The climate of the region is of type Aw (tropical hot-humid), with a dry winter season (Köppen 1928). The region had a maximum temperature of 30 °C, a minimum of 24 °C, and an average relative humidity of 34.25% during the year of the experimental study, according to INMET (automatic station A336), Alvorada do Gurgueia.

2.2 CHARACTERIZATION OF THE EXPERIMENT

The research was developed with acerola plants, genotypes BRS 366 Jaburu, Clone 09, Clone 13, Clone 14, Junko, and Sertaneja, all having one year of implantation, in the spacing of 4 x 3 m (833 plants ha^{-1}), planted on February 27, 2018, in a clayey yellow Latosol (Santos et al., 2013), under a drip irrigation system. The chemical and physical characteristics of the soil (Table 1), were determined at the implementation of the area, and liming and fertilization practices were performed according to the needs of the crop (Sousa and Lobato, 2004).

Table 1: Chemical and physical characteristics of the soil in the 0-20 cm depth of the acerola growing area - Fazenda Escola Alvorada Gurgueia – PI.

H^-	H^++Al^{3+}		Al^{3+}	Ca^{2+}	Mg^{2+}	K^+		T	P	K^+
H_2O	------------------------------mg.dm^{-3}-------------------------------								----mg.dm^{-3}----	
5.7	1.71		0	1.28	0.17	0.15		3.3	6.68	57.1
----------------Micronutrients------------										
Cu^{2+}	Fe^{2+}	B^+	Mn^{2+}	Zn^{2+}	V	M.O	Clay	Silt	Sand	
--------------mg.dm^{-3}---------------					%	%	g/kg	g/kg	g/kg	
2.37	153.28	1.59	37.23	1.7	48.1	6.5	64	29	907	

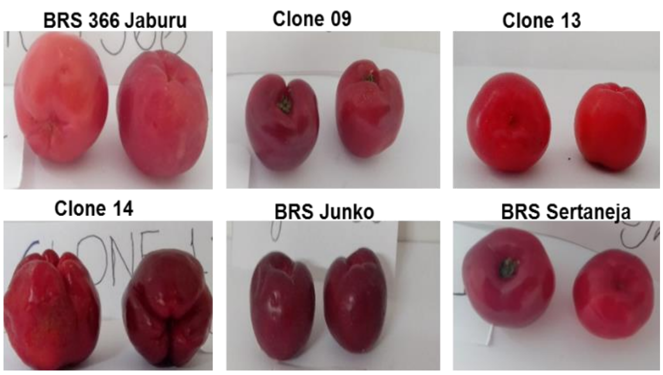
P, K, Cu, Fe, Mn, and Zn - Mehlich 1 Extractor; Ca, Mg, and Al - KCl Extractor - 1 mol/L; H + Al - Calcium acetate extractor at pH 7.0; Organic Matter (MO) - Walkley-Black method; Source: Center for Soil Analysis, Federal University of Piauí, Professora Cinobelina Elvas Campus, Bom Jesus, Piauí.

Source: authors

2.3 HARVEST AND ANALYZED VARIABLES

The fruits (represented in Figure 1) from the flowering of October 2019 were harvested ripe but firm to handle. The harvest was performed in the morning between 07:00 and 08:00 hours to take advantage of the cooler period of the day and avoid excessive respiration and consequent degradation of the fruit. We collected 750 g of fruit per block.

Figure 1: Fruits of acerola genotypes evaluated in the experiment.



Source: authors

After harvesting, the fruits were sorted, eliminating those that presented mechanical damage caused by insects or diseases. Afterward, the fruits were sanitized in water with 600 µL-1 active chlorine for five minutes. Ten fruits per repetition of each genotype were chosen to perform the physical analyses, and the rest of the fruits were centrifuged in a juicer (Philco). The pulp was extracted and immediately frozen in a vertical freezer at -20 °C.

The frozen pulp samples were transported in a thermal Styrofoam container to the laboratory of plant propagation of the Federal University of Piauí - UFPI, Campus Professora Cinobelina Elvas - CPCE, where the analyses were performed. The weight of the fruits (g) was determined on precision scales using the average of ten fruits, as well as for the other physical analyses. The transversal diameter and longitudinal diameter of the fruit were measured using a Pantec® digital pachymeter (model 11112AB-150), and the results were expressed in mm. A Coloração foi analisada nas regiões equatoriais do fruto, usando colorímetro CR-400 (Konica Minolta, Tokyo, Japan).

The results were expressed in "CIELAB" (CIE L*a*b*) color space. From these data, the chroma values (c*) were calculated, which correspond to the saturation or intensity of the color: $C* = (a*^2 + b*2)1/2$. Tint angle (h° angle) values were also calculated, expressed in degrees: h* = tang-1 (b*⁄a*) (Mcguire, 1992). Pulp yield was obtained by the ratio between pulp mass, after removing all the juice, and fruit mass, with subsequent conversion to percentage.

For the chemical analyses, the pulp from each experimental block was evaluated in triplicate. The pulp samples for anthocyanin and flavonoid analysis were extracted using a centrifuge (Philco) following the methodology described by Francis (1982). The results were expressed in milligrams of pigment per 100 g of fruit pulp.

Carotenoids were extracted with an acetone-hexane mixture (4:6), as described by Nagata and Yamashita (1992). Lycopene and β-carotene were estimated, and the results are expressed in mg/g. Titratable acidity (TA) was determined according to AOAC methodology. The results were expressed as a percentage of malic acid present in the pulp.

Ascorbic acid (AA) was determined by diluting 0.5 g of pulp in 50 ml of 2% oxalic acid and centrifuging at 8000 rpm for ten minutes, and the supernatant was used to titrate a mixture with 2 ml of a 0.02% solution of 2,6-diclofenac indophenol (DFI) added to 18 ml of water until it acquired a color identical to that of the titrant, as described by Oliveira et al. (2010). The results were expressed in mg of AA per 100 g of fruit.

2.4 STATISTICAL ANALYSIS

A randomized block experimental design was used, with three repetitions composed of three plants in each experimental plot, according to the genotypes tested, and each plant with approximately 250 g of fruits harvested for physical-chemical analysis. The data were submitted to variance analysis, and the means were compared by Tukey's test at 5% (p>0.05). A correlogram was generated by calculating the linear correlation coefficient (r) between the independent variables. All statistical analyses were performed using R software, version 3.2.5 (R core team, 2020).

3 RESULTS AND DISCUSSION

There was a significant effect of the genotypes on the variables productivity, mass, and longitudinal and transversal diameter of the acerola fruits (Table 2). Considering the estimated productivity among the six genotypes, clone 13 showed a higher average and was significantly different from the genotypes Junko and Sertaneja, with lower observed averages.

Table 2: Productivity, fruit mass (MF), longitudinal diameter (LD), and transverse diameter (TD) of acerola fruits cultivated in the southwestern region of Piauí.

Genotype	Productivity (t ha^{-1})	Fruit mass (g)	Longitudinal Diameter (mm)	Transverse Diameter (mm)
BRS 366 Jaburu	37.93 ± 1.00 ab	5.51 ± 0.39 a	18.42 ± 0.75 ab	22.80 ± 0.47 a
CLONE 09	39.33 ± 1.74 ab	5.02 ± 0.13 ab	19.72 ± 0.19 a	21.22 ± 0.10 ab
CLONE 13	51.09 ± 10.70 a	4.43 ± 0.16 ab	18.31 ± 0.22 ab	20.69 ± 0.18 ab
CLONE 14	35.86 ± 6.88 ab	4.61 ± 0.27 ab	18.16 ± 0.74 ab	21.31 ± 0.73 ab
JUNKO	22.96 ± 1.41 b	4.19 ± 0.60 b	17.32 ± 0.77 b	20.28 ± 0.84 ab
SERTANEJA	24.86 ± 1.45 b	4.40 ± 0.27 b	17.95 ± 0.03 b	20.08 ± 0.24 b
Value ‘F’	4.13*	1.73*	2.31*	3.57*
CV (%)	24.92	13.69	4.92	4.27

Means followed by the same letter in the column do not differ by Tukey's test at p>0.05 probability. CV: coefficient of variation.
Source: authors

To obtain an idea of the performance of Clone 13, its annual productivity was close to the values of the commercial genotype Sertaneja, in which it reaches approximately 57 t ha-1 year-1 (Embrapa, 2012). Moreover, the average is higher than productivity in commercial areas in the São Francisco Valley region, which is approximately 24.97 t ha-1 (CODEVASF, 2016). It is important to highlight the performance of the clones evaluated in the study region.

Furthermore, it is important to emphasize that in the present study, the productivity values can be higher in subsequent annual cycles, taking into account that the orchard under study presented less than two years of implantation during the collection period and that acerola production intensified from the third or fourth year of cultivation, as described by Oliveira et al. (2003).

Similarly, for MF, DT, and LD, Junko, and Sertaneja showed lower average performance when compared to the other variables, especially BRS 366 Jaburu and Clone 09. It is also possible to notice that the genotype BRS 366 Jaburu provided significant highlights for the indexes of brightness, chroma, and hue (Table 3).

Table 3: Average values of luminosity (L*), saturation (C*), and color tone (h°) of fruits of acerola genotypes cultivated in environmental conditions of the southwestern Piauiense - PI, Brazil.

Genotype	Luminosity	Croma	Hue
BRS 366 JABURU Jaburu	38.16 ± 1.51 a	47.68 ± 1.42 a	26.00 ± 1.15 a
CLONE 09	33.03 ± 0.47 ab	32.52 ± 2.62 b	22.33 ± 0.33 ab
CLONE 13	33.35 ± 1.83 ab	31.99 ± 3.31 b	18.33 ± 0.33 c
CLONE 14	31.07 ± 0.43 b	28.32 ± 0.57 b	21.00 ± 0.58 bc
JUNKO	32.68 ± 1.14 ab	31.51 ± 2.19 b	19.00 ± 1.15 bc
SERTANEJA	32.66 ± 2.01 ab	36.65 ± 4.22 ab	19.67 ± 0.33 bc
Value ‘F’	2.91*	6.39**	12.37**
CV (%)	7.33	13.53	6.58

Note: Means followed by the same letter in the column do not differ by Tukey's test at 5% probability. ± standard error of the mean (n = 4).
Source: authors

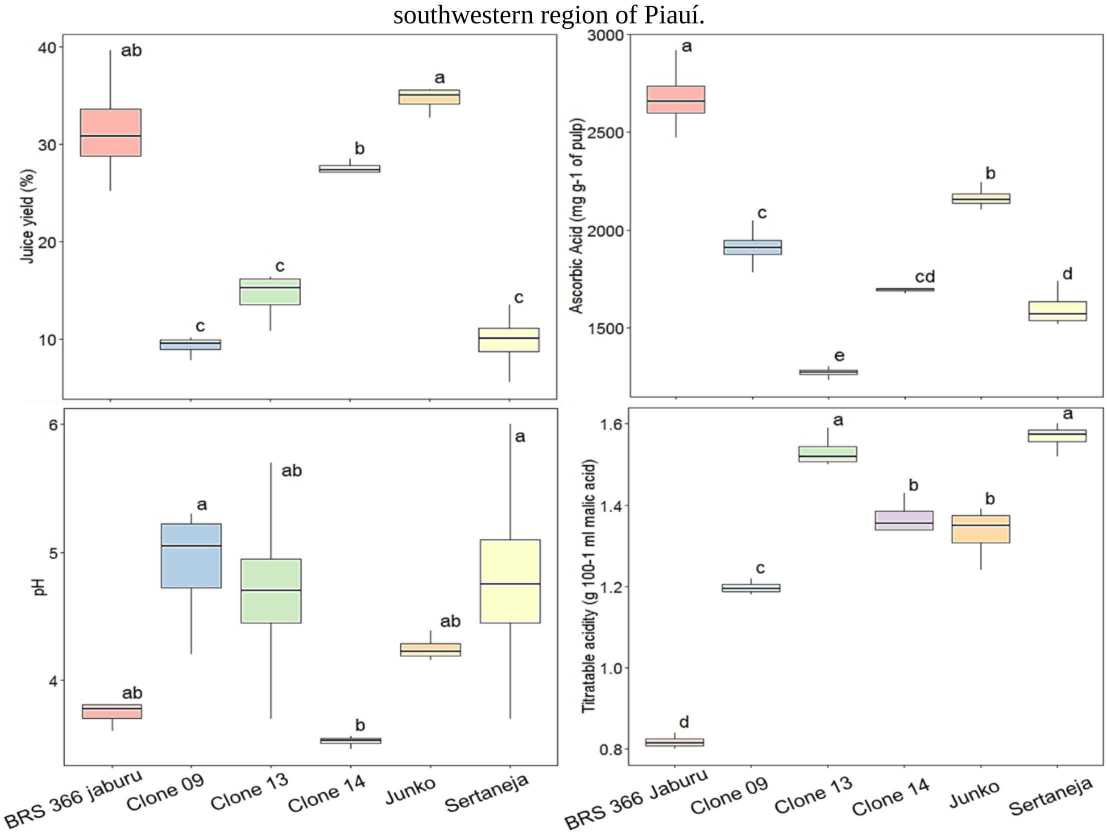
Presenting more discrepant differences, for luminosity, BRS 366 Jaburu presented an average of 22.81% higher than that presented by Clone 14, as well as 41.84% about Clone 13, when the Hue index was evaluated. Regarding the chroma index, the differences were more pronounced when compared to the evaluated clones and the commercial cultivar Junko (Table 3).

The color parameters, such as illumination (L*), saturation (C*), and color hue (h°), of the fruit, are three important factors in determining the commercial value of acerolas, indicating their quality, ripeness, and sweetness (Luo et al., 2019). Thus, in general, if we consider the illumination results compared to a scale that goes close to 100, we can state that this value falls within a darker illumination, close to red determined by the positive a value (+a) on the CIE l*a*b* scale (McGuire, 1992).

On the other hand, saturation, which is linked to the concentration of the color-giving element in the fruit, is a quantitative attribute for intensity and indicates the purity of the color. Thus, the fruits can be considered red, with medium brightness and high purity, especially BRS 366 Jaburu Jaburu. By analyzing the hue angle (h°), it is possible to reinforce that the colors of the fruits vary from red to yellowish since they are between the 0° and 90° angles, with a difference between the genotypes. While the first two present a more intense red coloration, BRS 366 JABURU reveals a tendency to be a slightly more yellowish fruit, presenting a greater angle about the others.

Similarly, although Clone 14 and BRS 366 Jaburu show more significant juice yield, when compared mainly to Clone 09, Clone 13, and Sertaneja, BRS 366 Jaburu shows a wider range of data ranging from 25 to 39% (Figure 2). Considering that the juice yield does not consider all the gross weight of the fruit, seed, and skin (epicarp) and reflects the total volume of the pulp, this is an important parameter to be compared with the chemical quality of the fruit because it may represent a greater quantity of functional and nutritional compounds. Importantly, this quantity is also intertwined with factors such as temperature, irrigation management, seasonality, nutrient addition to the soil, ultraviolet radiation, mechanical damage, and pathogen attacks (Yamaguchi et al.; 2017).

Figure 2. Juice yield, ascorbic acid, pH, and titratable acidity of the fruit of acerola genotype cultivated in the southwestern region of Piauí.



Source: authors

For ascorbic acid contents, BRS 366 Jaburu showed significant superiority over the other genotypes. The range of results was low, and its average was above 2,400 mg 100 g-1 of pulp, which no other genotype could reach, despite the low dispersion of values.

Therefore, it is noteworthy that only Clone 13 did not show values above the values cited in the Agroindustrial Indicators of the acerola cultivars released by Embrapa Agroindustrial Tropical, which was 1,463.00 mg 100 g-1 pulp (Embrapa., 2012), demonstrating that five genotypes proved to be within the expected improvement parameters, which is above 1,500 mg of ascorbic acid 100 g-1 pulp (Embrapa, 2000).

Interestingly, the most different metabolites, such as flavonoids, carotenoids, and anthocyanins, predominantly accumulate in mature fruits concerning still immature fruits. The opposite is true for ascorbic acid, which predominantly accumulates in green fruit. The high values found in the genotypes of the present study indicate that they are suitable both for consumption in nature, due to the excellent values of nutraceutical content found, and for the processing industry following the logic of the increase of vitamin C in green fruits.

For the pH values, although Clone 14 presented a low dispersion of the results, the average was statistically lower, especially compared to Clone 09 and Sertaneja (Figure 2C). Even presenting the lowest values, this result corroborates other results found in the literature, such as that of Cabbage et al. (2019), where acidic pH was also found at approximately 3.5 and decreased as the fruit was stored over time. As acerola is a slightly acidic fruit, it is normal to have low pH values due to the release of acids during the ripening period (Cabbage et al., 2019).

In the processing industry, especially in cosmetic formulation, in addition to vitamin C quality, pH also influences the formulation of epidermal extracts essential for structuring skin hydration. The acidification of the extracts is essential for the permeability of the epidermal barrier, and this process usually occurs at an acidic pH (Costa et al., 2012). For pulp industrialization, according to Normative Instruction No. 01 of January 7, 2000, the minimum pH value for pulp production is 2.8, and no maximum value is specified for it, with the genotypes studied being above this range.

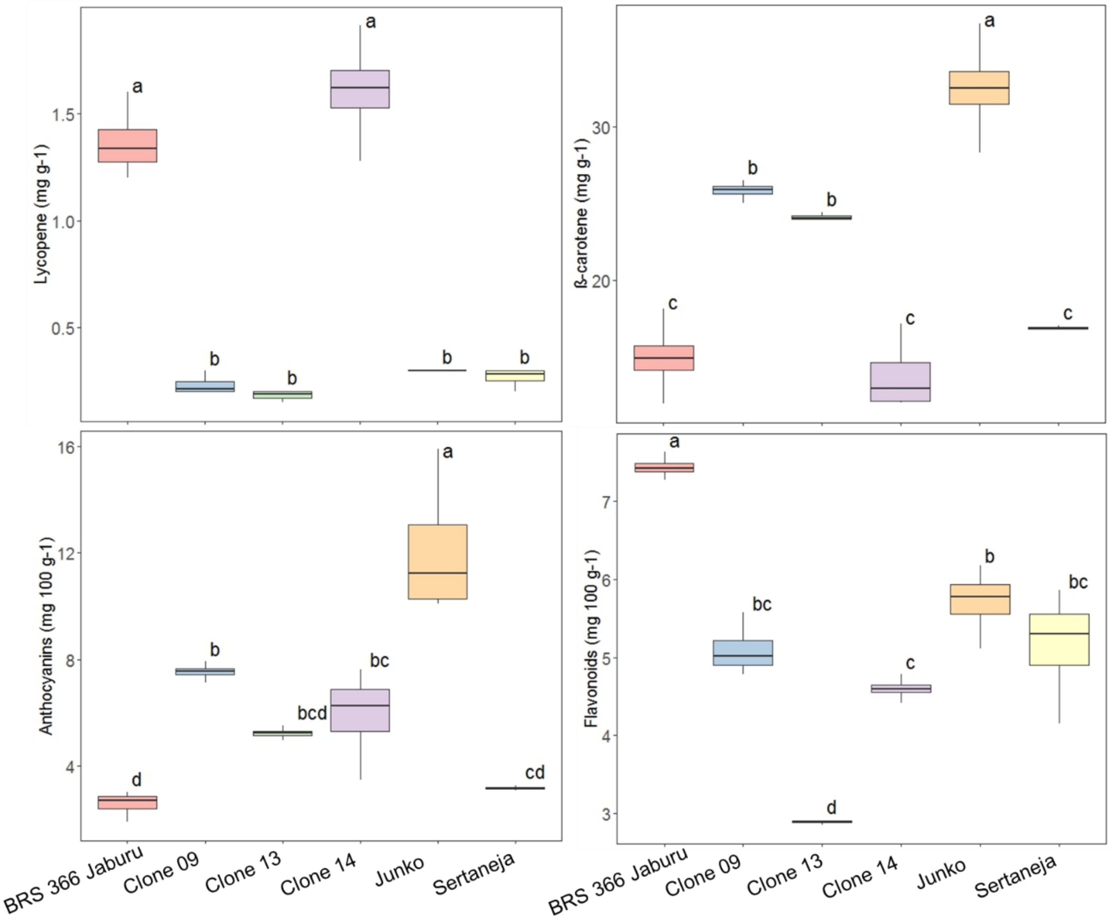
In contrast to the pH values, Sertaneja, followed by Clone 13, presented the highest titratable acidity values (Figure 2C), indicating that it required a greater amount of 1 N NaOH to neutralize the acidity of the pulp. In contrast, BRS 366 Jaburu presented the lowest titratable acidity, reaching values below 1.0 g 100-1 malic acid. The aforementioned higher values were above those found by Fachi et al. (2016), where among the genotypes analyzed, Sertaneja was one of those that presented the highest acidity (1.33).

Titratable acidity (TA) is considered a quality inherent to the organoleptic characteristics related to the flavor, texture, and odor of the fruit. The accumulation of this acid is associated with an interconnection of processes that occur in various compartments of a cell and seems to be under the control of several factors. From the maturation process, the concentration of malic acid, in the case of acerola fruits, tends to decrease, since they are solubilized into sugars by different metabolic processes, in particular respiration, where they serve as a substrate (ATP) to maintain their life utility (Etienne et al., 2013).

In addition, the low total acidity is crucial for consumption when eaten as fresh fruit. On the other hand, high total acidity is crucial for industrial fruit processing, as it reduces the need for artificial acid additives, although it is not a limiting factor in the selection of genotypes where other fruit quality parameters are satisfied (Nascimento et al., 2018)

For metabolites, previous studies have proven the presence of vitamins, polyphenols, carotenoids, and flavonoids in acerola (Barros et al., 2019). Many antioxidants have been identified in acerola fruits. For carotenoids, lycopene and β-carotene were observed in the present study. The highest amounts of lycopene, which were significantly different from the others, were found in the genotypes clone 14 and BRS 366 Jaburu (Figure 3A).

Figure 3. Mean values for chemical characteristics of fruit pulp of acerola genotype cultivated in the southwestern region of Piauí.



Source: authors

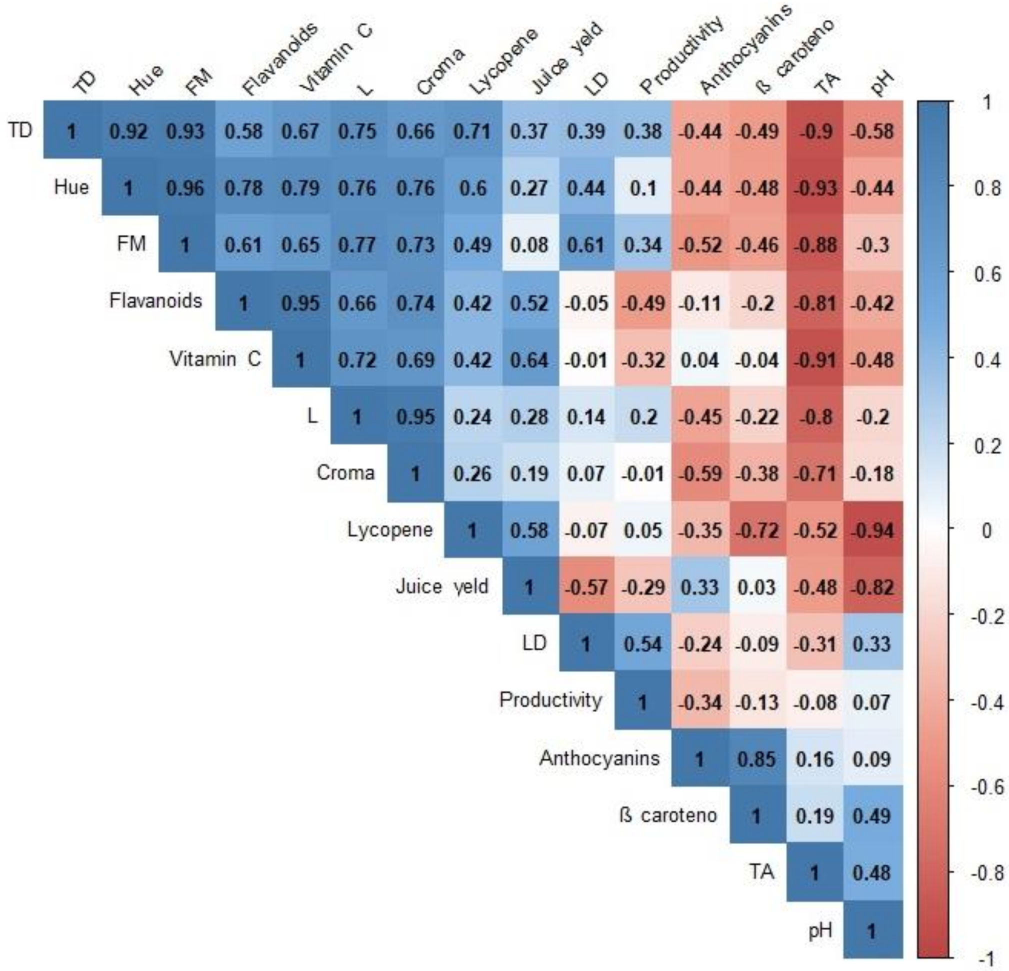
For β-carotene, the highest values were obtained for the 'Junko' genotype, averaging over 30.0 mg g-1 of fruit pulp. On average, according to the Brazilian Source of Carotenoids (2008), frozen acerola pulp presents approximately 11 mg g-1, with a variation of 8.8 to 38 mg g-1 depending on the stage and time for the analysis of this variable. Lycopene values were not quantified.

Carotenoids are important pigments of the class of bioactive compounds; ripe fruits tend to have a higher content of this bioactive compound than immature fruits. In general, the carotenes are yellow, which means that the total anthocyanin content is not as representative as in other fruits. The content of this pigment is also influenced by genotype, fruit exposure to radiation, and harvest time (Belwal et al., 2018).

Similar to the β-carotene contents, the highest concentrations of total anthocyanins were observed in the Junko genotype even though there was a wider range of the data (Figure xC), although the intense red coloration of the fruit epidermis was visible (Figure x). For yellow flavonoids, BRS 366 'Jaburu' stood out with low variation and values higher than 7.0 mg 100 g-1 of pulp, which characterizes the more orange coloration of its pulp, concerning the other genotypes that tend to have a more reddish coloration.

Figure 4 shows the correlation of variables for all genotypes, in which we observed positive and negative correlations between the factors evaluated. The color angles show a strong positive correlation, above 0.8, meaning, as expected, a link between them. The variables weight and diameter showed a strong negative correlation concerning titratable acidity, which means that the larger the fruit is, the lower the amount of malic acid, and the opposite is also true. This factor is justified by the biodegradation process of the fruit, in which chlorophyll degradation, starch breakdown, the action of hydrolytic enzymes, and, in this case, a decrease in acids occur. As the fruit develops, that is, its maturation occurs, and the acidity tends to be reduced mainly due to the decomposition of malic acid (Li et al., 2016).

Figure 4. Correlation analysis for productivity and physical-chemical characteristics of fruit pulp of acerola genotypes cultivated in the southwestern region of Piauí.



Source: authors

It is also expected that titratable acidity is related to the increase in ascorbic acid. Some studies point out that higher soluble solids and titratable acidity tend to have lower pH ratios used in fruit flavor identification and characterization (D'abadia et al., 2019). This would justify the increase in ascorbic acid, as it is directly intertwined with the soluble solids and acidity of the fruit.

A lower amount of titratable acidity also correlates to more yellow flavonoids and pigments with appearance according to ripening. For anthocyanin and β-carotene, there was a low and positive correlation with titratable acidity, indicating that more acidic acerola fruits may contain more of these antioxidants, while at the same time, they were strongly correlated with each other. Anthocyanin, lycopene, β-carotene, and ascorbic acid correlated positively, which is expected since these are phenolic compounds and all are related to antioxidant capacity (Chitarra; Chitarra, 2005).

For anthocyanins, a direct relationship between the levels of the red and purple coloration of the fruits was observed, and there was a strong and negative correlation with the chroma, which indicates the degree of purity of the color. This effect can be directly related to the response of the genotypes to the environment. For the genotypes, a positive relationship of productivity was observed with the parameters of the longitudinal and transversal diameter of the fruits but negative for the juice yield, which considers the amount of pulp after the removal of seeds.

In general, based on the data studied here, according to the physical characteristics, BRS 366 Jaburu stood out among the others, presenting excellent results for fruit mass and diameter, balance in acidity indexes, and high quantity of vitamin C and juice yield, which indicates its consumption both for the processing industry and for fresh consumption.

Finally, because it is a fruit with high climacteric activity, studies should now be endorsed seeking to analyze ways to maintain for a longer time these rich characteristics found in this small fruit that has already demonstrated great nutraceutical potential.

4 CONCLUSIONS

The BRS 366 Jaburu genotype stood out of the physical characteristics of the fruits. Although it was not the most productive, this genotype provided a better balance of titratable acidity and soluble solids, good content of total polyphenols, and a high amount of vitamin C allied to the yield of juice, which is required for acerola fruits. Thus, BRS 366 Jaburu shows promise for cultivation in the edaphoclimatic conditions of the southwestern region of Piauí.

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