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Bioactive compounds and antioxidant activity in tropical fruits grown in the lower-middle São Francisco Valley[1]

Compostos bioativos e atividade antioxidante de frutas tropicais cultivadas no Submédio do Vale do São Francisco

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ABSTRACT - The aim of this study was to evaluate the levels of bioactive compounds and antioxidant activity in fruit of commercial cultivars of mango, acerola, guava, atemoya and custard apple produced in the lower-middle São Francisco Valley, with a view to adding value to the product because of their functional properties. Fruits harvested in commercial areas of the region were evaluated for levels of ascorbic acid, total anthocyanins, yellow flavonoids, total carotenoids and total extractable polyphenols, and for total antioxidant activity, using the ABTS and ORAC methods. The data were submitted to descriptive statistical analysis. All the fruits under evaluation presented levels of bioactive compounds and antioxidant activity, especially the acerola, and in particular the Sertaneja and Okinawa cultivars, which may be considered excellent sources of natural antioxidants, with their consumption encouraged as part of a healthy diet. The significant positive correlation found between antioxidant activity and the levels of ascorbic acid, anthocyanins, yellow flavonoids, carotenoids and total extractable polyphenols with the two methods employed, shows that for the fruits under evaluation, this activity was influenced by the determined set of bioactive compounds.

Key words: Tropical fruit production. Functional properties. Quality.

RESUMO - Objetivou-se com o presente trabalho avaliar os teores de compostos bioativos e a atividade antioxidante dos frutos de cultivares comerciais de mangueira, aceroleira, goiabeira, atemoieira e pinheira produzidas no Submédio do Vale do São Francisco, com vistas à agregação de valor por meio de suas propriedades funcionais. Frutos colhidos em áreas comerciais da região foram avaliados quanto aos teores de ácido ascórbico, antocianinas totais, flavonoides amarelos, carotenoides totais, polifenóis extraíveis totais e atividade antioxidante total, pelos métodos ABTS e ORAC. Os dados foram submetidos à análise estatística descritiva. Todas as frutas avaliadas apresentaram teores de compostos bioativos e atividade antioxidante, com destaque para as acerolas, em particular as cultivares Sertaneja e Okinawa, podendo ser consideradas como excelente fonte de antioxidantes naturais e ter o seu consumo incentivado, como parte de uma dieta saudável. A correlação positiva e significativa encontrada entre a atividade antioxidante e os teores de ácido ascórbico, antocianinas, flavonoides amarelos, carotenoides e polifenóis extraíveis totais, nos dois métodos empregados, indica que nos frutos avaliados, essa atividade foi influenciada pelo conjunto de compostos bioativos determinados.

Palavras-chave: Fruticultura tropical. Propriedades funcionais. Qualidade.

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INTRODUCTION

Brazil is a major producer of fresh fruit and stands out for being one of the three largest producers in the world. Data show that 41.3 million tons were produced in an area of approximately two million hectares in 2014. Exports jumped from 296 thousand tons in 1998 to 819 thousand tons in 2015, an increase of 176.68% in 17 years (AGROSTAT, 2016; INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA, 2016).

Among the fruit-producing regions in Brazil, the lower-middle São Francisco Valley is one of the most important. It is in this region that the Petrolina-Juazeiro irrigated fruit-farming hub is located, where the planted area increased from 23 thousand hectares in 2012 to 25 thousand hectares in 2013, showing an advance of 7.5% (ANUÁRIO BRASILEIRO DA FRUTICULTURA, 2014).

This region is seen as a big generator of employment, producing on average two positions per irrigated hectare, totalling about 240,000 direct and 960,000 indirect jobs. Of particular note is production of the following fruit crops: grape, mango, banana, green coconut, guava, melon, acerola, lime, passion fruit, papaya, custard apple and others of lower production, giving an approximate volume of one million tons per year (MACIEL, 2011).

The contribution of this region to the market is not limited to the economic component, since fruit production supports regional development, but includes supplying food that can improve the quality of life of consumers. Fruit and vegetables are rich in vitamins, minerals and other compounds, such as carotenoids, ascorbic acid and numerous phenolic compounds, which have antioxidant action. As antioxidant systems and the needs of the various body organs differ, a combination of these substances may give better protection against the damage caused by free radicals (MURPHY *et al*., 2012; YUSOF; ISA; SHAH, 2012). Recently, disclosure of these chemical properties of fruit has stimulated consumption, the aim being to prevent disease. These compounds are known as bioactive compounds or occasionally as phytochemicals, and may play several roles in benefitting human health (LIU, 2013). Consequently, fruit has been the subject of several studies around the world, in which its nutritional value is highlighted, especially in relation to its antioxidant potential (ALMEIDA *et al*., 2011; MOO-HUCHIN *et al*., 2014; PAZ *et al*., 2015; SOUZA *et al*., 2014; VASCO; RUALES; KAMAL-ELDIN, 2008).

Considering the importance of fresh fruit to the Brazilian economy and diet, as well as the variations existing between genotypes of the same species, the aim of this study was to evaluate the levels of bioactive compounds and antioxidant activity in fruit of commercial cultivars of mango, acerola, atemoya and custard apple produced in the lower-middle São Francisco Valley, with a view to adding value to the product due to their functional properties.

MATERIAL AND METHODS

The fruit harvested for the study came from commercial orchards in the lower-middle São Francisco Valley, in the cities of Petrolina, Pernambuco and Juazeiro, Bahia (9º09’ S, 40º22’ W, at an average altitude of 365.5 m). According to the Köppen classification, the climate in the region is type Bswh, very hot semi-arid. The annual rainfall is 571 mm, with a mean annual temperature of 26.4 °C, a mean minimum of 20.6 °C and a mean maximum of 31.7°C (EMPRESA BRASILEIRA DE PESQUISA AGROPECUÁRIA, 2014).

The following were evaluated: the ‘Van Dyke’, ‘Tommy Atkins’, ‘Haden’, ‘Kent’, ‘Palmer’, ‘Keitt’, ‘Espada’ and ‘Rosa’ mangoes; the ‘Sertaneja’, ‘Okinawa’, ‘Costa Rica’ and Flor Branca’ acerolas; the ‘Paluma’, ‘Rica’ and ‘Pedro Sato’ guavas; the custard apple; and the ‘Gefner’ atemoya.

The mango, guava, custard apple and atemoya were harvested at physiological maturity (the ‘ready’ maturation stage). Once harvested, they were packed into cardboard boxes and transported to the Post-Harvest Physiology Laboratory of Embrapa Semiárido in Petrolina, Pernambuco, where they remained at room temperature (25.9 ± 1.7 °C and 66 °C ± 5% RH) until reaching the required maturation stage for the study (mature). For acerola, the ‘commercial’ maturation stage was adopted, characterised by the red colouration typical of the ripe fruit, but with the fruit still firm enough to withstand handling.

When the mango, guava, custard apple and atemoya were ripe, they were divided into four replications, each made up of 20 fruit from each cultivar. For the acerola, four replications were also used, with each consisting of a sample of 2 kg.

The variables analysed in the fruit pulp were: a) Ascorbic acid content (mg 100 g^{-1}): obtained by titration with Tillman’s solution (2.6-dichlorophenol indophenol, DFI), as per Strohecker and Henning (1967); b) Levels of anthocyanins and yellow flavonoids (mg 100g^{-1}): determined as per Francis (1982); c) Total carotenoid content (mg 100 g^{-1}): determined according to the method described by Higby (1962); d) Total extractable polyphenols (mg.100g^{-1}): according to a methodology described by Larrauri, Rupérez and Saura-Calixto (1997);

and e) Total antioxidant activity: using the $ABTS^+$ radical capture method as per Miller *et al*. (1993) with the adaptations made by Rufino *et al*. (2007), and the ORAC method, following the methodology described by Ou, Hampch-Woodill and Prior (2001).

In the mango, custard apple and atemoya, the absence in the pulp of the red, blue or violet colouration typical of anthocyanin pigments, made evaluation of this variable impossible.

The results were submitted to descriptive statistical analysis to obtain the mean and standard deviation for each fruit cultivar under analysis. Pearson's correlation analysis at a probability level of 1 and 5% was carried out between the bioactive compounds and the two methods of determining antioxidant activity.

RESULTS AND DISCUSSION

Ascorbic acid is recognised as an important antioxidant compound of natural origin (ALMEIDA *et al*., 2011; CONTRERAS-CALDERÓN *et al*., 2011). In this study, the highest levels of ascorbic acid, a precursor of vitamin C, were seen in fruit of the acerola cultivars, with emphasis on 'Okinawa' and 'Sertaneja', whose values were 2337.18 and 2075.13 mg 100 g^{-1} respectively (Table 1). After that, the fruit that presented the highest levels were the 'Paluma', 'Pedro Sato' and 'Rica' guava, in that order. Freire *et al*. (2013) reported levels of ascorbic acid for acerola (1457.69 mg 100 g^{-1}) similar to those obtained in this study for the Costa Rica cultivar. However, for guava (218 mg 100 g^{-1}), the levels reported by those authors were higher when compared to the three cultivars analysed in the present study.

In the mango, the ascorbic acid content ranged from 29.68 to 51.39 mg 100 g^{-1} pulp, with 'Palmer' having the highest content (Table 1). Ribeiro *et al*. (2015), investigating quality characteristics and the levels of bioactive compounds in mango accessions belonging to the Active Germplasm Bank of Embrapa Semiárido, found values for ascorbic acid in 'Haden' and 'Tommy Atkins' of 42.44 and 50, 60 mg 100 g^{-1} respectively, which were therefore greater than those seen in this study. The differences between the values for ascorbic acid may be associated with such factors as the maturation stage of the fruit, growing conditions and climate, among others. However, when compared to data from the national food composition table (UNIVERSIDADE ESTADUAL DE CAMPINAS, 2011), the values obtained in the present

Table 1 - Mean values for ascorbic acid, anthocyanins (ANT), yellow flavonoids (YF) and total carotenoids (TC) in the fruit of different cultivars from the lower-middle São Francisco Valley (mean ± SD, n = 4). Custard apple cultivar not identified. n.d. = not determined

Fruit	Cultivar	Ascorbic acid (mg 100 g^{-1})	ANT (mg 100 g^{-1})	YF (mg 100 g^{-1})	TC (mg 100 g^{-1})
Mango	'Van Dyke'	35.39 ± 2.29	n.d.	2.69 ± 0.17	1.92 ± 0.45
	'Tommy Atkins'	31.97 ± 3.71	n.d.	1.99 ± 0.40	1.15 ± 0.32
	'Haden'	29.71 ± 4.58	n.d.	2.71 ± 0.40	1.48 ± 0.62
	'Kent'	29.68 ± 2.63	n.d.	1.76 ± 0.17	1.48 ± 0.07
	'Palmer'	51.39 ± 6.84	n.d.	2.78 ± 0.14	1.48 ± 0.20
	'Keitt'	34.27 ± 2.64	n.d.	1.99 ± 0.20	1.97 ± 0.42
	'Espada'	34.27 ± 2.63	n.d.	1.95 ± 0.30	0.80 ± 0.22
	'Rosa'	34.26 ± 2.63	n.d.	2.26 ± 0.30	0.76 ± 0.11
Acerola	'Sertaneja'	2075.13 ± 9.95	10.90 ± 1.93	10.73 ± 0.94	3.28 ± 0.38
	'Okinawa'	2337.18 ± 82.73	13.0 ± 5.26	6.80 ± 1.40	1.62 ± 0.26
	'Costa Rica'	1454.85 ± 39.16	13.80 ± 2.42	9.90 ± 2.26	1.75 ± 0.54
	'Flor Branca'	1713.28 ± 136.18	7.03 ± 2.06	7.90 ± 1.89	1.65 ± 0.50
Guava	'Paluma'	78.80 ± 4.32	0.51 ± 0.26	3.53 ± 0.74	0.44 ± 0.15
	'Rica'	107.40 ± 7.98	0.40 ± 0.18	4.04 ± 1.01	0.75 ± 0.13
	'Pedro Sato'	81.08 ± 6.81	0.69 ± 0.36	3.24 ± 0.59	0.50 ± 0.27
Custard Apple		35.39 ± 2.27	n.d.	4.10 ± 0.47	n.d.
Atemoya	'Gefner'	25.11 ± 8.74	n.d.	5.51 ± 0.91	n.d.

study can be considered high, except for the custard apple (35.39 mg 100 g^{-1}) and 'Palmer' mango (51.39 mg 100 g^{-1}). For these, the values were similar to those presented in the table.

Acerola proved to be an excellent source of anthocyanins, especially the Costa Rica cultivar (13,80 mg 100 g^{-1}) and Okinawa cultivar (13,00 mg 100 g^{-1}), with levels within the range quoted by Oliveira *et al*. (Table 1), who reported values of 6.49 to 17.72 mg 100 g^{-1} in mature acerola clones produced in Limoeiro do Norte, in the State of Ceará (Table 1).

The guava displayed levels of anthocyanins ranging from 0.40 mg 100 g^{-1}, for the Rica cultivar, to 0.69 mg 100 g^{-1}, for the Pedro Sato. These levels are similar to those found in other tropical fruits (ALMEIDA *et al*., 2011; MOO-HUCHIN *et al*., 2014; RUFINO *et al*., 2010). As anthocyanins are related to the prevention of various diseases due to their functional properties, the consumption of fruits with significant levels of these compounds represents a form of protection for the organism.

In relation to the levels of yellow flavonoids, higher values were seen in the acerola cultivars, especially 'Sertaneja' (10.73 mg 100 g^{-1}) and 'Costa Rica' (9.90 mg 100 g^{-1}), as shown in Table 1, all of which were within the range given for accessesions of the Active Germplasm Bank of the Federal Rural University of Pernambuco (MACIEL *et al*., 2010), and of acerola clones produced in Limoeiro do Norte, Ceará. In a second group, the 'Gefner' atemoya (5.51 mg 100 g^{-1}), the custard apple (4.10 mg 100 g^{-1}) and the 'Rica' guava (4.04 mg 100 g^{-1}) were the most notable. The levels of yellow flavonoids in the fruits evaluated in this study were lower than those reported for blackberry (87.03 mg 100 g^{-1}), cherry (59.92 mg 100 g^{-1}), blueberry (47.53 mg 100 g^{-1}) and strawberry (38.17 mg 100 g^{-1}); however for raspberry (9.61 mg 100 g^{-1}) the levels were close to those obtained in some of the acerola cultivars (SOUZA *et al*., 2014).

Considering the levels of carotenoids in the pulp, the Sertaneja cultivar of acerola was important, with a mean value of 3.28 mg 100 g^{-1}, different from the other fruits evaluated in this study (Table 1). The mangoes presented levels of carotenoids varying from 0.76 mg 100 g^{-1} for the Rosa cultivar, to 1.97 mg 100 g^{-1} for the Keitt. These results are within the range reported by Oliveira *et al*. (2013) in accessesions of the 'Ubá' mango produced at the Sementeira Farm Experimental Station in Visconde do Rio Branco in the State of Minas Gerais, and by Ribeiro *et al*. (2015) for mango accessions produced at the Active Germplasm Bank of Embrapa Semiárido, of 0.61 to 2.12 mg 100 g^{-1} and 0.38 to 2.3 mg 100 g^{-1} respectively. Guava of the Paluma, Rica and Pedro Sato cultivars had the lowest mean levels of carotenoids. However, these were similar to those reported for cajá (0.7 mg 100 g^{-1}), cashew (0.4 mg 100 g^{-1}), camu-camu (0.4 mg 100 g^{-1}), carnauba (0.6 mg 100 g^{-1}), jambolão (0.51 mg 100 g^{-1}) and myrtle (0.5 mg 100 g^{-1}) (RUFINO *et al*., 2010).

The diversity of the crops, and the high levels of such compounds as carotenoids found in fruits produced in the lower-middle São Francisco Valley, deserve efforts to encourage regional and/or national consumption. Their expected effect, especially in relation to the carotenoid content, considering their recognised provitamin-A activity and action as bioactive substances, is to protect the health of those who consume fruits that present this type of compound.

Phenolic compounds have also received much attention in recent years for the health benefits they provide, related to their high antioxidant activity. The fruits richest in total extractable polyphenols were the acerola of the Okinawa (1,345.21 mg 100 g^{-1}), Sertaneja (1,101.01 mg 100 g^{-1}), Flor Branca (949.25 mg 100 g^{-1}) and Costa Rica (850.26 mg 100 g^{-1}) cultivars, followed by the 'Gefner' atemoya (237.81 mg 100 g^{-1}), the 'Pedro Sato' guava (149.97 mg 100 g^{-1}) and the custard apple (149.55 mg 100 g^{-1}), indicating that they are an important source of these compounds (Table 2). Silva *et al*. (2014) also found high levels of total extractable polyphenols in acerola pulp, confirming that this fruit is an excellent source of these compounds, in addition to having high amounts of anthocyanins and β-carotene.

According to Vasco, Ruales and Kamal-Eldin (2008), who studied 17 fruits from Ecuador in relation to polyphenol content, fruits are classified into three categories: low (<100 mg 100 g^{-1}), medium (100-500 mg 100 g^{-1}) and high (>500 mg 100 g^{-1}). Therefore, the acerola from the Sertaneja, Okinawa, Costa Rica and Flor Branca cultivars can be classified as having a high level of total extractable polyphenols. The 'Paluma', 'Rica' and 'Pedro Sato' guava; the 'Gefner' atemoya and the custard apple can be classified as having an average polyphenol content, which still qualifies them as being a good source of these compounds. In turn, the fruit of the mango cultivars has the lowest polyphenol content (16.51 to 36.04 mg 100 g^{-1}) as shown in Table 2. Paz *et al*. (2015), evaluating the pulp of eight types of tropical fruit, found high levels of polyphenols in acerola; intermediate levels in açaí, cajá, guava, mango and graviola, and low levels in pineapple and tamarind. These same authors found a total extractable polyphenol content in descending order for acerola>guava>mango, a result similar to that found in the present study for the same species.

In this study, antioxidant activity was evaluated using the ABTS organic radical and the ORAC peroxyl radical capture methods (Table 2). There is great diversity in the methods proposed in the literature for determining antioxidant activity, which consider the differences in the types of free radical, the action mechanisms, the sensitivity and the different forms of action in living organisms, and which generate results that can vary considerably. Using different methods to determine antioxidant activity therefore allows greater certainty and precision when indicating the antioxidant potential of fruit.

From the use of the above methods for evaluating antioxidant activity, the highest values were seen in the acerola from the Okinawa, Sertaneja, Flor Branca and Costa Rica cultivars, followed by the 'Gefner' atemoya, and the 'Pedro Sato 'and' Paluma' guava, indicating an association between antioxidant activity and polyphenol content (Table 2). These results highlighted the acerola as an excellent source of antioxidants, followed by the atemoya and guava; the consumption of these fruits should be encouraged, with a view to benefitting human health. According to the results, the lowest antioxidant activity was seen in the fruit of the mango cultivars, when using both the ABTS radical capture method (1.0 to 3.0 μM Trolox g^{-1} pulp) and the ORAC peroxyl radical capture method (2.03 to 4.29 μM Trolox g^{-1} pulp). Paz *et al*. (2015), evaluating antioxidant activity in the pulp of tropical fruits using the DPPH and FRAP methods further highlighted higher values for acerola, confirming the results obtained in the present work. The authors also saw the formation of a second group including açaí, guava, mango, cajá, and graviola, and a third group with the lowest values of antioxidant activity, formed by custard apple and tamarind, agreeing with their report on polyphenol content.

Rufino *et al*. (2010), studying bioactive compounds and antioxidant activity in Brazilian tropical fruits, found a value of 96.6 μM Trolox g^{-1} pulp in acerola using the ABTS method. This result is lower than that found in this study for the Sertaneja, Okinawa and Flor Branca cultivars, but greater than for the Costa Rica cultivar.

Moo-Huchin *et al*. (2014), when evaluating by the ABTS method the antioxidant activity of tropical fruits produced in Mexico, reported mean values of 6.46 μM Trolox g^{-1} pulp and 6.55 μM Trolox g^{-1} pulp in custard apples with green and purple peel respectively. These values are lower than those obtained in the present work for atemoya from the Gefner cultivar (16.89 μM Trolox g^{-1} pulp) and the custard apple (12.75 μM Trolox g^{-1} pulp) using the same method. The greater antioxidant activity obtained in atemoya and custard apple produced under specific environmental conditions, such as the lower-

Table 2 - Mean values obtained for total extractable polyphenols (TEP) and total antioxidant activity by the ABTS and ORAC methods in the fruit of different cultivars from the lower-middle São Francisco Valley (mean ± SD, n = 3). Custard apple cultivar not identified

Fruit	Cultivar	TEP	ABTS	ORAC
		(mg 100 g^{-1})	(μM Trolox g^{-1} pulp)	(μM Trolox g^{-1} pulp)
Mango	'Van Dyke'	26.90 ± 0.88	2.4 ± 0.21	2.83 ± 0.38
	'Tommy Atkins'	17.26 ± 2.19	1.0 ± 0.07	2.69 ± 0.00
	'Haden'	23.45 ± 0.52	2.0 ± 0.12	3.29 ± 0.64
	'Kent'	16.51 ± 1.56	1.4 ± 0.12	2.03 ± 0.31
	'Palmer'	36.04 ± 3.43	3.0 ± 0.18	3.11 ± 0.00
	'Keitt'	22.81 ± 1.28	1.4 ± 0.23	2.85 ± 0.12
	'Espada'	30.32 ± 3.08	1.9 ± 0.06	3.27 ± 0.40
	'Rosa'	32.17 ± 2.14	2.7 ± 0.10	2.93 ± 0.28
Acerola	'Sertaneja'	1101.01 ± 10.75	115.82 ± 4.70	66.82 ± 4.82
	'Okinawa'	1345.21 ± 5.24	144.77 ± 8.65	69.70 ± 3.99
	'Costa Rica'	850.26 ± 13.44	78.27 ± 0.77	45.20 ± 8.02
	'Flor Branca'	949.25 ± 11.00	122.72 ± 4.81	60.40 ± 3.78
Guava	'Paluma'	120.21 ± 0.76	13.30 ± 0.97	15.89 ± 1.37
	'Rica'	108.05 ± 6.01	8.47 ± 0.31	9.29 ± 1.44
	'Pedro Sato'	149.97 ± 8.20	15.31 ± 0.81	17.23 ± 0.34
Custard Apple		149.55 ± 1.93	12.75 ± 0.90	21.49 ± 3.42
Atemoya	'Gefner'	237.81 ± 6.51	16.89 ± 1.47	41.52 ± 7.21

Table 3 - Correlations between the levels of bioactive compounds and total antioxidant activity by the ABTS and ORAC methods in the fruit of different cultivars produced in the lower-middle São Francisco Valley

	ABTS	ORAC	Polyphenols	Carotenoids	Flavonoids	Anthocyanins
Ascorbic acid	*0.573	**0.907	**0.972	**0.862	**0.990	**0.989
Anthocyanins	*0.510	**0.851	**0.978	**0.856	**0.991	
Flavonoids	*0.527	**0.920	**0.973	**0.886		
Carotenoids	*0.563	**0.874	**0.914			
Polyphenols	*0.553	*0.830				
ORAC	*0.766					

** and * indicate significant correlations at 1 and 5% probability respectively by t-test

middle São Francisco Valley, is an advantage that, as it remains stable throughout the various harvests, can be used to incentivise consumption in markets of interest.

The correlation coefficient between the antioxidant activity determined by the ABTS and ORAC methods and the levels of the bioactive compounds ascorbic acid, anthocyanins, yellow flavonoids, carotenoids and total extractable polyphenols are shown in Table 3. There was a significant positive correlation between the two methods of determining antioxidant activity (*0.766), indicating that they had a similar response. Both can therefore be used to quantify antioxidant activity in the different fruit cultivars evaluated in the present study, with the same type of information being generated.

There was a significant correlation between the bioactive compounds ascorbic acid, anthocyanins, yellow flavonoids, carotenoids and total extractable polyphenols and the antioxidant activity determined by the ABTS and ORAC methods, with this correlation being positive in both cases. It can therefore be said that all these variables are closely related to antioxidant activity. However, differing results can be found in the literature regarding the contribution of each of the bioactive compounds to antioxidant activity in fruit.

Several studies have reported the strong correlation between total extractable polyphenols and antioxidant activity, claiming it to be the most important component (ALMEIDA *et al*., 2011; MOO-HUCHIN *et al*., 2014). Whereas, the studies by Contreras-Calderón *et al*. (2011) and Rufino *et al*. (2010) reported a positive correlation between both total extractable polyphenols and ascorbic acid with antioxidant activity in exotic fruits produced in Colombia and Brazil respectively. Souza *et al*. (2014), studying the chemical composition, bioactive compounds and antioxidant activity of fruit produced in subtropical areas of Brazil, reported a positive correlation between the levels of total extractable polyphenols (0.83), flavonoids (0.84), anthocyanins (0.85) and antioxidant activity quantified by the ABTS radical method, confirming the results of the present study.

Several studies have been carried out in the different sectors with the aim of discovering new nutritional sources. The functional importance of these compounds to human health has motivated countless studies to determine the concentrations of such compounds in the most-consumed foods, especially in fruit. The study of bioactive compounds and antioxidant activity in the principal fruits produced in the lower-middle São Francisco Valley thus contributes to encourage conscious consumption and to add value to the fruits under study, by highlighting the potential benefits to human health, as well as supporting the decisions of the producer regarding commercial strategies and when defining which cultivar or cultivars should be the focus of production.

CONCLUSIONS

1. All the fruits under evaluation presented levels of bioactive compounds and antioxidant activity, especially acerola, and in particular, the Sertaneja and Okinawa cultivars, allowing them to be categorised as an excellent source of natural antioxidants;
2. The significant positive correlation between antioxidant activity and the levels of ascorbic acid, anthocyanins, yellow flavonoids, carotenoids and total extractable polyphenols in both methods employed, shows that, for the fruits under evaluation, this activity was influenced by the determined set of bioactive compounds.

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