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RESEARCH PAPER

Characterization of a Fermented Feijoa Beverage

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Abstract

G.V. Sartori, M.J. Montibeller, G. Furini, A.P. de L. Veeck, W.G. Sganzerla, P.C. Beling, A. de O. Rios, and V. Manfroi. 2020. Characterization of feijoa fermented beverage. Int. J. Agric. Nat. Resour. This study aimed to prepare a feijoa wine and to assess its physicochemical parameters, bioactive compounds, and antioxidant activity. Feijoa were harvested at physiological maturation, and their pulp was fermented in a BOD device at 16 ± 2 °C for 15 days. After the fermentation process, the beverage was characterized for its physicochemical parameters, total phenolic compounds and total flavonoids by spectrophotometry, carotenoids by HPLC, and antioxidant activity by the FRAP, DPPH, and ABTS methods. These same analyses were performed on the pulp *in natura* for comparative and evaluation purposes of the process. The feijoa fermentation process had a high yield (82%), and the physicochemical characteristics were in accordance with this class of beverage. The beverage had high antioxidant activity, while six carotenoids were identified in the fruit *in natura*, with (all)-*trans*-lutein and β-cryptoxanthin being the major carotenoids, in addition to a phenolic content of 176.22 mg GAE 100 g^{-1} and a total flavonoid content of 0.11 mEq quercetin 100 g^{-1}. The wine had a lower bioactive compound content but a higher antioxidant activity than the pulp. Feijoa wine is a viable technological product in addition to exhibiting antioxidant activity.

Key words: *Acca sellowiana* (O. Berg) Burret, beverage technology, carotenoids, fermented fruit beverage.

Introduction

There are currently several technological processes that may be used to fully implement foods with nutritional and functional quality for humans. One of the most commonly employed processes for this is the transformation of sugar-rich raw materials into alcoholic beverages. Wines are likely the most traditional products of this class, with records of their production dating back over 7,500 years (Davidovic *et al*., 2013) using grapes as a raw material. However, with the evolution of fermentation techniques in many countries and the requirement for the complete use of fruit products, wine also refers to fermented

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alcoholic beverages made from other fruits using the same manufacturing process, which is represented by fruit wine and fermented fruit beverages (Jagtap & Bapat, 2015).

The fermentation process may be an excellent option for using food products that have been neglected over the years. In addition to generating products that are greatly enjoyed by consumers and using harvest excess, it allows for extraction of *in natura* insoluble bioactive compounds from the raw material, which increases the bioavailability of these bioactive compounds during consumption and be consumed inter-harvest period (Jagtap & Bapat, 2015). In this way, many researchers have employed viniculture production methodologies to develop fermented beverages from fruits, such as lychee (Alves *et al*., 2011), peach (Davidovic *et al.,* 2013), cocoa, cupuassu, gabiroba, jabuticaba, umbu (Duarte *et al.,* 2010a), raspberry (Duarte *et al*., 2010b), and mango (Varakumar *et al*., 2011), among others. However, it is important to determine the intrinsic characteristics of food to be used industrially to achieve a high-quality process.

The feijoa (*Acca sellowiana* (O. Berg) Burret) is a species of the Myrtaceae family native to the southern Brazilian highlands and northeast Uruguay. Internationally, feijoa is more extensively grown in countries such as the United States, New Zealand, Colombia, Italy, and Uruguay. In Brazil, it is more commonly found in cold climate areas at altitudes above 800 m, such as in the Serra Gaúcha and in fields at high altitudes of the states of Rio Grande do Sul, Santa Catarina, and Paraná (Weston, 2010). In the past ten years, scientific interest in feijoa has significantly increased, mostly in Brazil, New Zealand, and Italy. However, most of those studies focus on the agronomical potential, postharvest potential, and nutraceutical potential, with a lack of studies on the technological characteristics of this fruit.

Feijoa is known not only for its acidic sweet flavor and intense aroma but also for being a source of phenolic compounds (Saj *et al*., 2008), such as catechin, eriodictyol, eriocitrin, pyrocatechol, quercetin, rutin, ellagic, gallic, and syringic acids (Ferrara *et al*., 1999; Lapcik *et al*., 2005; Monforte *et al*., 2014), α-, β-, γ-, and σ-tocopherol, flavone, stigmasterol, β-carotene (Ruperto & Tringali, 2004; Monforte *et al*., 2014), and C and B vitamins, in addition to minerals, such as iron, calcium, potassium, zinc, phosphorus, manganese, and magnesium (Basile *et al*., 1997; Weston, 2010). A number of studies aimed to determine the bioactive compounds and showed the fruit's antioxidant potential (Beyhan *et al*., 2010; Weston, 2010; Pasquariello *et al.,* 2015; Sun-Waterhouse *et al*., 2013; Tuncel & Yilmaz, 2013).

Due to the nutritional importance and the lack of scientific studies on products derived from feijoa, this research aimed to prepare a fermented beverage (wine) using the pulp of this fruit, characterize its physicochemical parameters, and examine the amount of antioxidant and bioactive compounds present in it.

Materials and Methods

Samples

Fruits were randomly collected at maturation, which was identified by the easy detachment of the fruit through touch, in the city of São Joaquim, SC (28°16'40.02"S, 49°56'09.10"W, 1,400 m altitude) in the 2016 season. After harvest, the fruits were transported in a polyethylene box to the Institute of Science and Technology of Santa Catarina, Urupema Campus, where they were processed at the Laboratory of Fruit and Vegetable Technology.

First, the fruits were cleaned in running water and sanitized with 200 ppm sodium hypochlorite (NaClO) for 15 min. Then, they were cut in half with stainless steel knives, and the pulp was manually removed and stored at -5.0 ± 2 °C in plastic bags until subsequent analyses.

Fermented Beverage

The fermented beverage was prepared based on the production techniques of white wine and guava wine (Bertagnolli *et al.,* 2017). The feijoa pulp was thawed at 5.0 ± 2 °C and put in a blender at low speed for a few seconds to achieve greater homogenization. The sample was transferred into 20 L polyethylene recipients. Each recipient received 12 kg of pulp and was sulphited with 200 ppm potassium metabisulphite. After 30 min, Lafazym® extract (Laffort) pectinolytic enzyme was added at 4 g 100 kg^{-1}. The fermentation recipients with the sample were stored in a LimaTec 320 TFP-II BOD device for 2 h at 16 ± 2 °C, inoculum was added, and chaptalization was performed until 18 °Brix (mash at 12 °Brix) was achieved. The inoculum was prepared with a glycosylated solution (50 g L^{-1}) at 38 ± 2 °C with 25 g 100 kg^{-1} *Saccharomyces cerevisiae* yeast (Zimaflor Delta) and a two-phase ammonium phosphate fermentation nutrient, perlite, and thiamine hydrochloride (Thiazote®, Laffort, 10 g 100 kg^{-1}). After 48 h, when the sample was in full fermentation, another 15 g 100 kg^{-1} fermentation nutrient was added. The fermentation occurred in the same BOD device at a controlled temperature of 16 ± 2 °C for 15 days. After alcoholic fermentation, the fermented beverage was clarified using low temperatures (1 ± 2 °C), a gelatin clarifier (50 mL L^{-1}), and silica (30 mL L^{-1}). Subsequently, the samples underwent sulphitation, (30 ppm potassium metabisulphite), filtration, and bottling. Fermentation was carried out in duplicate.

Physicochemical Analyses

To identify the initial fermentation parameters, feijoa pulp was assessed for its total soluble solids (TSS) content using refractometry and expressed as °Brix, total titratable acidity (TTA) using neutralization titration with 0.1 M NaOH and expressed as mg 100 g^{-1} citric acid and pH through direct reading with a digital pH meter (MS Tecnopon mPA-210) (Instituto Adolfo Lutz, 2008).

The wine was also analyzed for its pH; total acidity (TA) was determined by neutralization titration with 0.1 M NaOH and expressed as mEq L^{-1}; volatile acidity (VA) was determined by steam distillation followed by titration with 0.1 M NaOH and expressed as mEq L^{-1}; fixed acidity was determined by subtracting the volatile acidity from the total acidity and expressed as mEq L^{-1}; the alcohol content was determined by distillation (% v/v) (Instituto Adolfo Lutz, 2008); the TSS content; the reducing sugar (RS) content was determined by the Lane-Eynon method and expressed as g L^{-1} (Amerine & Ough, 1980); the density was determined by immersion of a densimeter directly into the sample; the total and free SO_2 contents were determined by the Ripper method and expressed as mg L^{-1} (Zoecklein *et al*., 2001), and the total dry extract was also determined (Instituto Adolfo Lutz, 2008). Fermentation yield was calculated by the quotient between the volume of fermented beverage produced and the amount of pulp used. At bottling, the analyses were performed in triplicate.

Bioactive compound quantification

The total phenolic compound concentration was determined by Swain and Hillis (1959) with modifications described by Sganzerla *et al.* (2019). The reaction was composed of 104 µL of the sample extract (1 mL of fermented wine in 10 mL of distilled water), 1667 µL of distilled water, 104 µL of 0.25 N Folin-Ciocalteu reagent, and 208 µL of 1 mol L^{-1} sodium carbonate. The absorbance was measured in a spectrophotometer (UV-Vis 752D, Labman, China) at 725 nm, and the standard curve was performed using gallic acid (0.4 mg mL^{-1}). The results were expressed as mg of gallic acid equivalent (GAE) per 100 mL (mg GAE 100 mL^{-1}).

Total flavonoid compounds were determined according to Zhishen, Mengcheng and Jianming (1999) with modifications. Two milliliters of deionized water and 150 *µL of sodium nitrite solution*

(5%) were added to 500 µL of each extract. After 5 min 150 µL of a 10% aluminum chloride solution was added. After more than 5 minutes of incubation, 1 mL of 1 mol L^{-1} sodium hydroxide was added, and the absorbance measurements were acquired in a spectrophotometer (λ=510 nm). Quercetin was used as a standard for the calibration curve. The results were expressed as mg of quercetin equivalent (QE) per 100 mL (mg QE 100 mL^{-1}).

Carotenoids were identified and quantified using high-performance liquid chromatography (HPLC) according to Mercadante and Rodriguez-Amaya (CLAE), Rodrigues *et al.* (2013), and Crizel *et al.* (2016). The pigments from 20 g of sample were completely extracted with acetone (until the sample lost its color), added to a mixture of distilled water and petroleum ether/ethyl ether (1:1 (v/v)) in a separatory funnel, and saponified with a 10% KOH solution in methanol overnight at room temperature. Distilled water was used to clean the extracts until elimination of the alkali. The oily fraction of the mixture in the funnel was added to anhydrous sodium sulfate and concentrated in a rotary evaporator (Fisatom, model 801/802, Brazil). The concentrated extract was transferred to an amber glass flask, dried with nitrogen, and redissolved in 300 µL MeOH:MTBE (50:50 (v/v)) (MTBE - JT Baker, CAS Number 1634-04-4, 99.96% purity). Prior to injection into the chromatograph, the extract was sonicated (Unique, model USC 1400) and filtered in a disposable hydrophilic Teflon filtration unit with 0.45 mm porosity (Millex LCR). Extraction and injection were performed in triplicate in a Waters e2695 chromatograph coupled to a diode array detector (DAD).

The carotenoids were separated in a C_{30} YMC column (5 µm, 250 mm × 4.6 mm) using a linear gradient of a MeOH:MTBE mixture as the mobile phase from 95:5 (v/v) to 70:30 (v/v) for 30 min, followed by an adjustment to 50:50 (v/v) over 20 min and maintaining this ratio for 15 min. The mobile phase flow was 0.9 mL min^{-1}, and the column temperature was set to 29 °C. The spectra were obtained between 200 nm and 600 nm, and the chromatograms were processed at 450 nm. The combined results of the following parameters were considered in the identification of compounds: order of elution in the C_{30} column and characteristics of the UV/vis spectra (maximum absorption wavelength (λ_{max})) compared with those of the standards analyzed under the same conditions and with data available in the literature. Carotenoids were quantified using an analytical curve of the external standard β-carotene (Sigma-Aldrich, St Louis, MO) with concentrations of 0.125, 0.25, 0,5, 1, 3, 6, 10, 12, 15, and 20 µg mL^{-1} (linear curve: R^2 = 0.998; LD = 0.1 µ mL^{-1}; LQ = 2.75 µ mL^{-1}), and the results were expressed as µg g^{-1} sample. During the extractions and analyses, the samples were protected from solar and artificial light using amber glassware and aluminum foil.

Antioxidant activity determination

Antioxidant activity through the removal of the 1,1-diphenyl-2-picrylhidrazyl (DPPH) radical was determined according to Brand-Williams, Cuvelier and Berset (1995). A total of 150 µL of extract (1 mL of fermented wine in 10 mL of distilled water) and 2850 µL of a 0.1 mM DPPH solution were added, and the absorbance (λ=515 nm) was recorded after 24 hours (UV-Vis 752D, Labman, China). The calibration curve was generated with 1 mM Trolox, and the results were expressed as mg of Trolox equivalent antioxidant capacity (TEAC) per mL (mg TEAC mL^{-1}).

Antioxidant activity through the removal of the acid 2,2′-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid (ABTS) radical was determined according Re *et al.* (1999) with modifications. To 30 µL of each extract, 3000 µL of $ABTS^{+}$ solution was added and homogenized in a tube shaker. After 6 minutes in the dark, the absorbance of the resultant color was measured at 734 nm in a spectrophotometer (UV-Vis 752D, Labman, China), and a Trolox

standard (2 mM solution) was used to generate a calibration curve. The results were expressed as mg of Trolox equivalent antioxidant capacity (TEAC) per mL (mg TEAC mL^{-1}).

The FRAP (ferric reduction antioxidant power) was determined according to Benzie and Strain (1996) with modifications described by Sganzerla *et al.* (2019). Aliquots of 100 µL of each extract were added to 100 µL of ferric chloride (3 mM) and 1800 µL of TPTZ (2,4,6-tris(2-pyridyl)-s-triazine) (1 mM). The reaction was maintained for 30 minutes in a water bath to 37 ºC. The absorbance was measured at 620 nm (UV-Vis 752D, Labman, China), and Trolox (1 mM solution) was used to generate a calibration curve. The results were expressed as mg of Trolox equivalent antioxidant capacity (TEAC) per mL (mg TEAC mL^{-1}).

Statistical Analysis

All analyses were carried out in triplicate, and the results are expressed as the mean ± standard deviation. The mean values obtained for the fermented beverage were compared to those of feijoa by analysis of variance (ANOVA) and Student's t-test at 5% probability using the software Statistica version 7.0 (StatSoft Inc. 2011, Tulsa, OK, USA).

Results and Discussion

Physicochemical Properties

Alcoholic fermentation is a biological process that converts sugars, such as glucose, fructose, and saccharose, into cellular energy with the production of ethanol and carbon dioxide as metabolic residues. The physicochemical parameters of the raw material and of the wine produced and analyzed in this research are described in Table 1.

After water, ethanol is the main element of alcoholic beverages, such as fermented fruit beverages. It is the basis of all aromas and flavors of the beverage. The alcohol content is related to the content of total soluble solids in the raw material, the density, and the reducing sugars of alcoholic beverages. The fermentation process of feijoa had a yield of 82%, a density of 0.997 g mL^{-1}, and a mean alcohol content of 9.7% (v/v). Such values are proportional to the amount of total soluble solids initially contained in the mash (12 °Brix)

Table 1. Physicochemical parameters of feijoa pulp and wine (TSS=total soluble solids; TTA=total titratable acidity; VA=volatile acidity; FA=fixed acidity; TA=total acidity; RS=reducing sugars)

	Parameter	Value	RV†
Pulp	pH	3.29 ± 0.01	-
	TSS (°Brix)	12.00 ± 0.58	-
	TTA (mg 100 g^{-1} citric acid)	1.02 ± 0.01	-
Wine	pH	3.24 ± 0.02	-
	VA (mEq L^{-1})	3.50 ± 2.12	Maximum 20.0
	FA (mEq L^{-1})	186.50 ± 0.0	Minimum 30.0
	TA (mEq L^{-1})	190.00 ± 0.0	50.0 to 130.0
	Alcohol content % (v/v) at 20 °C	9.70 ± 0.70	4.0 to 14.0
	RS (g L^{-1})	3.60 ± 0.0	-
	TSS (°Brix)	6.72 ± 0.01	-
	Density (g mL^{-1})	0.997 ± 0.001	-
	Dry extract (g L^{-1})	8.241 ± 0.06	Minimum 7.0
	Total SO_2 (mg L^{-1})	24.00 ± 2.26	-
	Free SO_2 (mg L^{-1})	11.20 ± 2.26	-
	Fermentation yield (%)	82.30 ± 1.25	-

†Reference values (BRASIL, 2009).

and are satisfactory for maintaining the beverage's sensory characteristics and stability. For the residual reducing sugar content, the feijoa wine may be classified as dry according to the Regulation of the Commission of the European Communities (EC) nº 753/2002.

Acid-related factors impact the sensory characteristics and physicochemical and biological stability of fermented beverages. Despite the high acidity, due to the fruit's characteristic acidity and the influence of the fermentation process, the fermented beverage had a low volatile acidity content, which shows the good quality of the fruit and the favorable fermentation conditions employed. The fermentation activity may impact acidity since it acts on the capacity of producing organic acids, such as succinic, pyruvic, lactic, citric, acetic, and gluconic acids (Carvalho *et al*., 2005), and the release of organic acids into the sample during maceration (Rizzon & Miele, 2002). New studies must target the identification and quantification of the acids present in the feijoa wine and their relation to the acids contained in the pulp *in natura*.

pH is an important parameter that impacts color and has a pronounced effect on the taste of a beverage. Beverages with high pH are more susceptible to oxidative and biological alterations since the free sulfur dioxide content is proportionally lower than those with low pH values (Rizzon & Miele, 2002). To improve the levels of the desired characteristics, the pH must be between 3.1 and 3.6, which was the pH range of the wine in this study. Sensorially, the feijoa fermented beverage has a clear golden-yellow color and characteristic flavor and aroma of the fruit.

Bioactive Compounds and Antioxidant Activity

Since the fermentation process may impact the chemical composition of the final product, the bioactive compounds were assessed both in the pulp *in natura* and in the feijoa wine. The results obtained for the determinations of total phenolic compounds, total flavonoids, and carotenoids are described in Tables 2 and 3.

The total phenolic compound contents observed in the fruit pulp and in the feijoa wine were significantly different from each other ($p<0.05$), with higher values in the pulp than in the wine. The lower value observed in the wine may be related to the high reactivity of phenolic compounds during and after fermentation, which react via condensation, complexation, and polymerization.

The total phenolic compounds recorded in this study for the feijoa wine (104.13 mg GAE 100 mL^{-1}) were higher than those observed in other studies with extracts of this fruit. Tuncel and Yilmaz (2013) noticed contents of 16.2 mg GAE g^{-1} in feijoa extracts; Isobe *et al*. (2003) reported contents of 59.0 mg GAE 100 g^{-1}; and Sun-Waterhouse *et al*. (2013) reported 46.1 mg catechin g^{-1} total phenolic compounds, which were lower than in the present study.

For the fresh pulp, other studies reported contents between 130.0 and 196.43 mg GAE 100 g^{-1} for samples from the city of São Joaquim (Petry *et al*., 2017), between 92.88 and 251.02 mg GAE 100 g^{-1} for Italian samples (Pasquariello *et al.,* 2015), and 366.14 mg GAE 100 g^{-1} for Uruguayan samples (Silveira *et al.,* 2015). The differences observed between the data in the present study and in other studies are due to factors, such as differences in plant variety, cultivation site, edaphoclimatic conditions, management systems, and agricultural practices, which impact the composition of plant products.

Flavonoids are a group of substances of varied chemical structure, and quercetin is the main flavonoid in the human diet (Behling *et al*., 2004). Thus, this structure was used to assess the total flavonoid content in the samples of feijoa pulp and the fermented beverage, expressing the results as mEq quercetin 100 g^{-1} or mL of sample, respectively (Table 2). The total flavonoid content

between the pulp and the wine did not significantly differ from each other ($p>0.05$), which showed that the processing of the beverage maintained the contents of those substances present in the fruit *in natura*.

The literature has limited data on feijoa carotenoids. Ruperto and Tringali (2004) identified β-carotene as the representative compound of this class of compounds in the fruit. The results observed for the identification and quantification of carotenoids in feijoa pulp in this study are presented in Table 3 and Figure 1.

In feijoa pulp, six carotenoids were identified, with (all)-*trans*-lutein and β-cryptoxanthin (both at 0.019 μg g^{-1} fresh pulp) as the major carotenoids, followed by γ-carotene (0.010 μg g^{-1} fresh pulp). In addition to xanthophylls, ζ-carotene and γ-carotene were identified, which are also known to be bioactive. Regarding the carotenoid observed at 34.8 min, it was suggested to be a derivate of β-carotene due to the observed characteristics.

No carotenoids were identified in the fermented beverage produced in this study, which indicates probable breakdown of those compounds during processing. According to Rodriguez-Amaya (2010), the polyenic chain, responsible for the desirable properties of carotenoids, is also the cause of their instability. Isomerization and oxidation of carotenoids occur under some conditions, such as during homemade preparation, industrial processing, and food storage. Heat, light, and acids promote the isomerization of *trans* carotenoids–as they are normally found in nature–into the *cis* form, with reduced loss of color and biological activity. Oxidation, the main cause of carotenoid breakdown, depends on the availability of oxygen, type of carotenoid, and physical status. This process is stimulated by light, color, metals, oxidative enzymes, and peroxides

Table 2. Total phenolic compounds (mg GAE 100 mL^{-1} for the fermented beverage and mg GAE 100 g^{-1} for the pulp), total flavonoids (mEq QE 100 mL^{-1} for the fermented beverage and mEq QE 100 g^{-1} for the pulp) and antioxidant activity determined by the DPPH, ABTS, and FRAP methods (mg TEAC mL^{-1}) in feijoa pulp and wine(mean ± SD).

Analyses	Pulp	Wine
Total Phenolic Compounds	176.22 ± 6.60 [a]	104.13 ± 5.13 [b]
Total Flavonoids	0.11 ± 0.01 [a]	0.12 ± 0.01 [a]
DDPH	194.95 ± 5.59 [b]	737.45 ± 16.63 [a]
FRAP	1,496.53 ± 14.28 [b]	3,484.63 ± 19.32 [a]
ABTS	274.03 ± 4.84 [b]	315.49 ± 11.37 [a]

The same letters in the same row do not differ according to Student's t-test at 5% probability.

Table 3. Chromatographic characteristics and UV/Vis absorption data of the carotenoids identified in the feijoa pulp by HPLC-DAD.

Peak	Carotenoid	t_R (min)	λ_{max} (nm)	% III/II	Concentration (μg g^{-1} pulp)
1	(all)-*trans*-lutein	12.8	420. 443. 472	55	0.019 ± 0.008
2	(all)-*trans*-zeaxanthin	14.9	423. 449. 476	20	0.009 ± 0.002
3	β-cryptoxanthin	23.6	426. 450. 477	31	0.019 ± 0.008
4	ζ-carotene	33.9	378. 399. 424	108	0.005 ± 0.003
5	n.i.[†]	34.8	411. 433. 456	-	0.006 ± 0.003
6	γ-carotene	42.4	436. 459. 486	35	0.010 ± 0.004
	Total carotenoids (μg g^{-1} fresh pulp)				0.0685

[†]n.i.= not identified

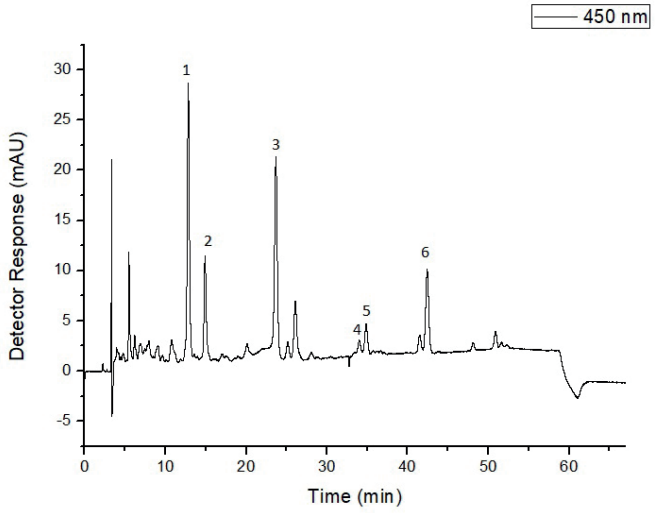

Figure 1. Chromatogram obtained via HPLC-DAD at 450 nm for carotenoids in feijoa pulp: 1. (all)-*trans*-lutein; 2. (all)-*trans*-zeaxanthin; 3. β-cryptoxanthin; 4. ζ-carotene; 5. Not identified; 6. γ-carotene. Chromatographic conditions: See text.

and is inhibited by antioxidants. Enzyme oxidation can occur when the food is peeled, cut, grated, or ground since the breakdown of cell structures that protect carotenoids releases enzymes and carotenoids, which causes oxidation. Carotenoid loss depends on the carotenoids present, the degree of cell structure destruction, and the processing temperature and time.

Three methods were employed (DPPH, ABTS, and FRAP) to obtain more accurate tests about the antioxidant capacity of the products in this study. In all of them, the antioxidant activity in the pulp and in the wine were significantly different, with higher activity values in the beverage than in the fruit *in natura* ($p<0.05$). Since the bioactive compounds studied in this research were present at a lower proportion in the beverage, it was suggested that this higher antioxidant activity was due to the synergy with ethanol and the complexity of fermented alcoholic beverage composition.

The antioxidant activity observed in this study both for the pulp and for the wine was higher than in the pulps of other fruits (Sartori *et al*., 2014) and red wines (Gonzeli & Sartori, 2014). The antioxidant activity may depend on several factors, including the colloidal properties of the substrates, the oxidation conditions and steps, and radical formation and stability, as well as the possible location of antioxidants and stability at different phases of food processing. When a complex matrix is employed, as is the case for foods, different compounds may establish countless different interactions between each other and with solvents.

The feijoa wine proved to be a viable technological product using an excess product. Studies on the specific phenolic compounds in this wine may be carried out to more comprehensively determine how their chemical conformation is impacted by the fermentation process. Studies on other products derived from *A. sellowiana* by this research group are under way and will be publicized.

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Resumen

G. V. Sartori, M. J. Montibeller, G. Furini, A. P. de L. Veeck, W. G. Sganzerla, P. C. Beling, A. de O. Rios, y V. Manfroi. 2020. Caracterización de bebida fermentada de feijoa. Int. J. Agric. Nat. Resour. El objetivo de este trabajo fue preparar un vino de feijoa y evaluar sus parámetros fisicoquímicos, compuestos bioactivos y actividad antioxidante. La feijoa se cosechó en el punto de maduración fisiológica y su pulpa se fermentó en un dispositivo BOD a 16 ± 2 °C, durante 15 días. Después del proceso de fermentación, la bebida se caracterizó por sus parámetros fisicoquímicos, compuestos fenólicos totales y flavonoides totales por espectrofotometría, carotenoides por HPLC y actividad antioxidante por los métodos FRAP, DPPH y ABTS. Los mismos análisis se realizaron en la pulpa en forma natural para fines comparativos y de evaluación del proceso. El proceso de fermentación de feijoa fue un alto rendimiento (82%) y características fisicoquímicas de acuerdo con esta clase de bebidas. La bebida mostraron una alta actividad antioxidante, mientras que se identificaron seis carotenoides en la fruta *in natura*, siendo (*all*) -trans-luteína y β-criptoxantina los principales, además de un contenido fenólico de 176.22 mg GAE 100 g^{-1} y 0.11 mEq de quercetina 100 g^{-1} flavonoides totals. El vino tuvo un menor contenido de compuestos bioactivos, pero una mayor actividad antioxidante. El vino de feijoa es un producto tecnológico viable además de exhibir actividad antioxidante.

Palabras clave: *Acca sellowiana* (O. Berg) Burret, bebida de fruta fermentada, carotenoides, tecnología de bebidas.

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