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ORIGINAL ARTICLE

Manufacture of uvaia nectar and evaluation of physicochemical stability during storage

Fabricação de néctar de uvaia e avaliação da estabilidade físico-química durante o armazenamento

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ABSTRACT:

Brazilian Cerrado fruits have a great diversity of bioactive compounds, with significant relevance for fresh consumption and industrial processing. The uvaia (*Eugenia pyriformis* Cambess) stands out among these fruits, seeing that this species contains high phenolic compounds and ascorbic acid levels. However, its technological and nutritional potential is still little explored industrially. This research aimed to develop three uvaia nectar formulations and to evaluate its stability during 90 days of storage. The formulations were made with 30%, 40%, and 50% of uvaia pulp, corresponding to F1, F2, and F3 formulations, respectively, which were characterized for pH, total titratable acidity, soluble solids, ascorbic acid, and total phenolics during 0, 30, 60, and 90 days of storage at room temperature. A significant pH reduction was observed after 30 days of storage for all nectars. The acidity and ascorbic acid levels increased in proportion to the addition in the pulp concentration of the formulations. The ascorbic acid content reduced over the storage period and remained higher for the formulations F2 and F3. The concentration of phenolic compounds was higher in the nectar containing relevant levels of uvaia pulp concentration, which increased throughout 30 days of storage, however, with a decrease after this period. The formulations containing 40% and 50% of uvaia pulp showed higher concentration and better stability of bioactive compounds. Uvaia can be considered an effective raw material for the development of a novel beverage with important nutritional and bioactive properties.

Keywords: Beverage; Fruits; Bioactive compounds; Phenolic compounds; Ascorbic acid; Storage.

RESUMO

Os frutos do cerrado possuem uma grande diversidade de compostos bioativos, sendo interessantes para o consumo *in natura* e após processamento industrial. A uvaia (*Eugenia pyriformis Cambess*) se destaca entre estes frutos, pois apresenta alto conteúdo de compostos fenólicos e ácido ascórbico. Entretanto, o seu potencial tecnológico e nutricional ainda é pouco explorado industrialmente. A presente pesquisa teve o objetivo de desenvolver três formulações de néctar de uvaia e avaliar a sua estabilidade durante 90 dias de armazenamento. Para tanto, foram elaboradas três formulações de néctar contendo 30% (F1), 40% (F2) e 50% (F3) da polpa de uvaia, analisadas quanto aos parâmetros pH, acidez total titulável, sólidos solúveis totais, ácido ascórbico e compostos fenólicos totais, durante 0, 30, 60 e 90 dias de armazenamento à temperatura ambiente. O pH dos néctares foi significativamente reduzido após 30 dias de armazenamento. O aumento da acidez e do conteúdo de ácido ascórbico foi proporcional à elevação da concentração de polpa utilizada na formulação da bebida. O conteúdo de ácido ascórbico foi reduzido ao longo do período de armazenamento e permaneceu mais elevado para as formulações F2 e F3. A concentração de compostos fenólicos foi maior no néctar com maior proporção de polpa de uvaia, sendo este parâmetro aumentado durante os 30 dias de armazenamento e reduzido após este período para todas as formulações de néctar. As formulações contendo 40% e 50% de polpa de uvaia apresentaram maior concentração e melhor estabilidade de compostos bioativos. A uvaia pode ser considerada uma importante matéria-prima para o desenvolvimento de uma bebida inovadora e com importantes propriedades nutritivas e bioativas.

Palavras-chave: Bebida; Frutas; Compostos bioativos; Compostos fenólicos; Ácido ascórbico; Armazenamento.

1 Introduction

The national production of nectar has increased significantly in recent years. In 2010, the production of the beverage reached 743,749.00 liters, thus increasing to 1,815,018.00 liters in 2019. Although a reduction of 17.3% in nectar consumption was observed between 2015 and 2016, there was a market growth from 2017 to 2019, with a 68.9% increase in the nectar consumption (Associação Brasileira das Indústrias de Refrigerantes e de Bebidas Não Alcoólicas, 2020). Probably, the evolution of the nectar market is due mainly to changing consumption habits, combined with the development of new beverages and consumer convenience.

The development of new beverages is necessary for the maintenance and growth of the productive sector. Thus, the use of Cerrado fruits in nectar formulations may be an interesting alternative, seeing that these fruits contain a great diversity of bioactive compounds (phenolic compounds, carotenoids, vitamins, and dietary fibers), with great relevance for the production of a healthy beverage (Matsuura & Rolim, 2002; Neves et al., 2011; Morzelle et al., 2011).

In this context, uvaia fruits (*Eugenia pyriformis* Cambess) could stand out, and this species is characterized by yellow-orange color, as well as presenting adequate properties for the production of beverages, ice cream, and jams (Reitz et al., 1988; Silva et al., 2008; Gomes, 2012; Tomaz et al., 2019). Uvaia has high phenolic compounds and ascorbic acid contents when compared to other Brazilian fruits (Rufino et al., 2010; Silva et al., 2014; Zillo et al., 2014), which improves its antioxidant potential, contributing to the reduction of oxidative stress and the risk of developing cardiovascular diseases (Lopes et al., 2018).

Thus, the potential of uvaia fruits should be explored, aimed to develop a high-quality beverage with important sources of nutrients and bioactive compounds. Owing to the lack of studies on the industrial processing of these fruits, the present research aimed to develop three uvaia nectar formulations and to evaluate the physicochemical stability of the nectars during storage.

2 Material and methods

2.1 Raw materials

The nectars were obtained from uvaia fruits (*E. pyriformis* Cambess) grown in the Fruit Sector of the Federal Institute of Education, Science, and Technology of the Triângulo Mineiro (*Instituto Federal de Educação, Ciência e Tecnologia do Triângulo Mineiro* (IFTM)), in the Uberaba campus. The other ingredients were commercial sucrose and mineral water.

2.2 Preparation of the fruit nectar

The uvaia fruits were harvested at the Fruit Sector of the IFTM, in the Uberaba campus, and immediately taken to Fruit and Vegetable Processing Sector at IFTM. The fruits were washed under running water for removing impurities and superficial microorganisms, and then immersed in a sanitizing solution containing 50 ppm of free residual chlorine for 10 minutes, and again washed under running water.

The uvaia fruits were pulped in a stainless steel brush type pulping machine equipped with a 1.0 mm diameter sieve. The pulp was placed in plastic containers and stored at 20 ºC.

The nectar formulations were made with the addition of 30%, 40%, and 50% of uvaia pulp (corresponding to Formulations 1, 2, and 3, respectively), by using mineral water and crystal sugar to standardize the total soluble solids at 15 °Brix.

The nectars were subjected to heat treatment at 90 ºC for 5 minutes and hot-filled in 200 mL glass bottles (sterilized), capped with a plastic screw cap, cooled under running water, and stored at room temperature.

2.3 Characterization of uvaia pulp and nectar

The characterization of uvaia pulp and nectars was carried out at the IFTM Bromatology Laboratory, in the Uberaba campus. The pulp was characterized for pH, and these samples were measured in a potentiometer (TEC-11, Tecnal), and then underwent quantification of Total Soluble Solids (TSS) using a bench refractometer (AR200, Reichert) and the results were expressed as °Brix (Instituto Adolfo Lutz, 2008), total Titratable Acidity (TA) by titration of the sample with 0.1M NaOH and the results expressed as g citric acid 100 mL^{-1} (Instituto Adolfo Lutz, 2008), ascorbic acid according to the Tillman's method (2,6-dichlorophenol-indophenol) and the results expressed as mg ascorbic acid 100 mL^{-1} (Instituto Adolfo Lutz, 2008). The uvaia nectars were characterized for TSS using a bench refractometer (AR200, Reichert) and the results expressed as °Brix (Instituto Adolfo Lutz, 2008), total TA by titration of the sample with 0.1N NaOH and the results expressed as g citric acid.100 mL^{-1} (Instituto Adolfo Lutz, 2008), ascorbic acid according to the Tillman's method (2,6-dichlorophenol-indophenol) and the results expressed as mg ascorbic acid 100 mL^{-1} (Instituto Adolfo Lutz, 2008), and the total phenolic compounds by Folin and Ciocalteu method (Folin & Ciocalteu, 1927) during the storage (0, 30, 60, and 90 days).

2.4 Statistical analysis

A Completely Randomized Design (CRD) was used, in a 3 x 4 factorial scheme, with three replications, considering the nectar concentrations (30%, 40%, and 50% of uvaia pulp) as the first factor, and the time of storage (0, 30, 60, and 90 days) as the second factor.

The results were subjected to analysis of variance by the F test, and the significant differences were analyzed by Tukey's test ($p < 0.05$), and regression analysis was used for the storage periods (Ferreira, 2000).

3 Results and discussion

The uvaia pulp presented higher acidity levels when compared with many traditional fruits such as acerola, passion fruit, strawberry, grape, and guava (Kuskoski et al., 2006; Sousa et al., 2020). The pH and the total soluble solids of the pulp were close to those found by Scalon et al. (2004), which found average values of 2.87 and 6.2º Brix, respectively. Rufino et al. (2010) reported lower ascorbic acid content in uvaia pulp when compared with this study, similarly to other authors, who also reported lower ascorbic acid levels in other Cerrado fruits, including puçá-preto, gurguri, cajá, ata, ciriguela, and bacuri (Souza Filho et al., 2002; Rufino et al., 2010) (Table 1).

The characterization of uvaia pulp demonstrated its great technological potential for industrialization, mainly due to its greater acidity, which can contribute to the reduction of microbial growth, as well as its maintenance ascorbic acid content.

Table 1. Characterization of uvaia pulp.

Parameters	Uvaia pulp
Total Titratable Acidity (TA) in citric acid	2.34 g 100 mL^{-1}
Total Soluble Solids (TSS) (°Brix)	5.5
Ascorbic acid	46.2 mg 100 mL^{-1}
pH	2.47

Significant changes were observed among the nectar formulations during the storage for the parameters pH, ascorbic acid, and phenolic compounds, at a 5% significance level, whereas the total acidity levels differed only among the formulations. No significant differences were observed for the soluble solids content of the beverages among the formulations and storage times, remaining at values close to 15º Brix (data not shown).

The results showed that the average pH value of the nectars was 3.44 at the beginning of storage, which reached an average value of 3.09 after 90 days, with no significant differences among the formulations (Table 2).

The pH values considerably reduced throughout 30 days of storage for all formulations. After this period, significant changes in pH were observed among the formulations, with similar results until the end of 90 days (Figure 1). Mattietto et al. (2007) also reported a significant pH reduction of mixed cajá and umbu nectar during the 30 days of storage, and Maeda et al. (2007) found a reduction in pH during the storage of camu-camu nectar. Probably, the organic acid composition of the uvaia pulp may have affected the pH values of the beverage during storage.

Table 2. Mean pH values and analysis of variance of uvaia nectar formulations throughout the storage.

Formulations	Time of storage (days) pH			
	0	30	60	90
F1	3.41 ± 0.01^{b}	3.10 ± 0.01^{a}	3.14 ± 0.01^{a}	3.12 ± 0.01^{a}
F2	3.48 ± 0.06^{a}	3.10 ± 0.01^{a}	3.09 ± 0.01^{b}	3.08 ± 0.00^{ab}
F3	3.43 ± 0.01^{b}	3.12 ± 0.02^{a}	3.08 ± 0.01^{b}	3.06 ± 0.00^{b}

Means followed by the same letter do not differ by Tukey's test ($p \geq 0.05$). Different superscript letters indicate significant differences among the formulations for the same time of storage. F1 = 30% of uvaia pulp; F2 = 40% of uvaia pulp; F3 = 50% of uvaia pulp.

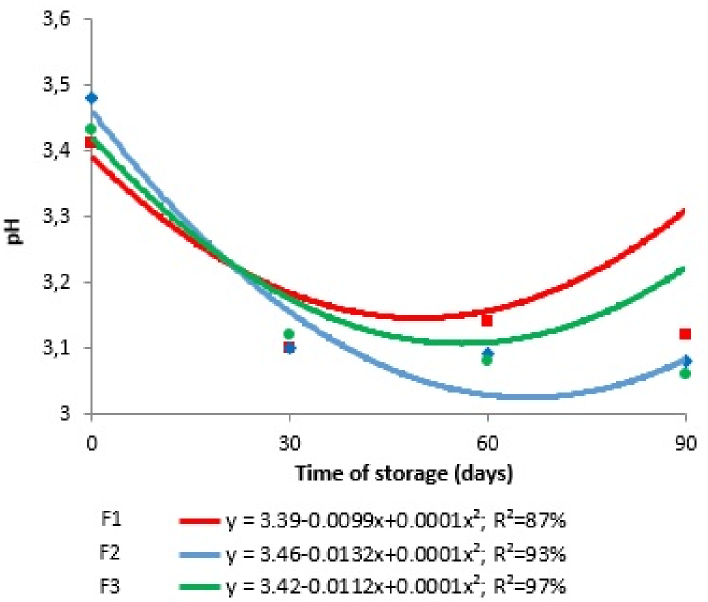

Figure 1. Regression analysis of the pH values of uvaia nectar formulations stored at room temperature.

The total TA levels of the nectars were proportional to the uvaia pulp concentrations used in the formulations, for all storage periods (Table 3), with no significant regression analysis for this parameter. This behavior is due to the acidic character of uvaia fruits, as observed in the characterization of the pulp. The acidic character of uvaia can be a relevant factor for the preservation of the beverage, once it allows reducing the development of undesirable microorganisms and increases the oxidative stability of ascorbic acid during the storage. The acidulating potential of organic acids combined with pH reduction is an important mechanism for reducing microbial growth and ascorbic acid degradation (Bedetti et al., 2013; Massager, 2005; Maeda et al., 2006; Tomaz et al., 2019)

Table 3. Mean total Titratable Acidity (TA) values and analysis of variance of uvaia nectar formulations throughout the storage.

Formulations	Time of storage (days) Total TA (g citric acid 100 mL^{-1})			
	0	30	60	90
F1	0.66 ± 0.01^{c}	0.72 ± 0.04^{c}	0.63 ± 0.01^{c}	0.66 ± 0.01^{c}
F2	0.87 ± 0.00^{b}	0.95 ± 0.01^{b}	0.80 ± 0.05^{b}	0.86 ± 0.02^{b}
F3	1.10 ± 0.01^{a}	1.21 ± 0.04^{a}	1.01 ± 0.02^{a}	1.12 ± 0.02^{a}

Means followed by the same letter do not differ by Tukey's test ($p \geq 0.05$). Different superscript letters indicate significant differences among the formulations for the same time of storage. F1 = 30% of uvaia pulp; F2 = 40% of uvaia pulp; F3 = 50% of uvaia pulp.

The results in Table 4 show that, concerning the freshly prepared beverage, the ascorbic acid concentration was higher for the formulation F3, due to the higher uvaia pulp concentration. Similar ascorbic acid concentrations were observed for the formulations with the addition of 40% and 50% of pulp after 30 and 90 days of storage, indicating that these formulations can provide the same content of this vitamin during the periods studied.

The polynomial adjustments showed that the average ascorbic acid concentrations reached minimum values at day 56, 66, and 90 of storage, for the formulations F1, F2, and F3, respectively (Figure 2). Although the formulation F2 exhibited a lower ascorbic acid concentration at 66 days of storage, i.e., a small reduction of 7.8% was observed from 60 to 90 days. In contrast, the formulation F3 containing a higher pulp content showed a 27% reduction of the ascorbic acid concentration during this period. This behavior could indicate that the content of this acid remained almost stable in formulation F2 after 60 days of storage.

Ascorbic acid has antioxidant, anti-inflammatory, antihypertensive, and hypolipidemic properties, and can act in the prevention of various diseases such as cancer, osteoporosis, septicemia, eye problems, and cardiovascular disease (Daud et al., 2016). Thus, the nectars with the addition of 40% and 50% of uvaia pulp can contribute to the supply of higher levels of this vitamin, even after storage at room temperature.

Table 4. Mean ascorbic acid levels and analysis of variance of uvaia nectar formulations throughout the storage.

Formulations	Time of storage (days) Ascorbic acid (mg 100 mL^{-1})			
	0	30	60	90
F1	13.6 ± 0.3^{c}	7.0 ± 1.7^{b}	7.2 ± 2.0^{c}	8.4 ± 0.8^{b}
F2	18.6 ± 1.3^{b}	12.8 ± 0.3^{a}	11.0 ± 1.1^{b}	11.8 ± 0.9^{a}
F3	22.4 ± 0.6^{a}	14.8 ± 0.7^{a}	13.7 ± 0.7^{a}	10.8 ± 1.2^{a}

Means followed by the same letter do not differ by Tukey's test ($p \geq 0.05$). Different superscript letters indicate significant differences among the formulations for the same time of storage. F1 = 30% of uvaia pulp; F2 = 40% of uvaia pulp; F3 = 50% of uvaia pulp.

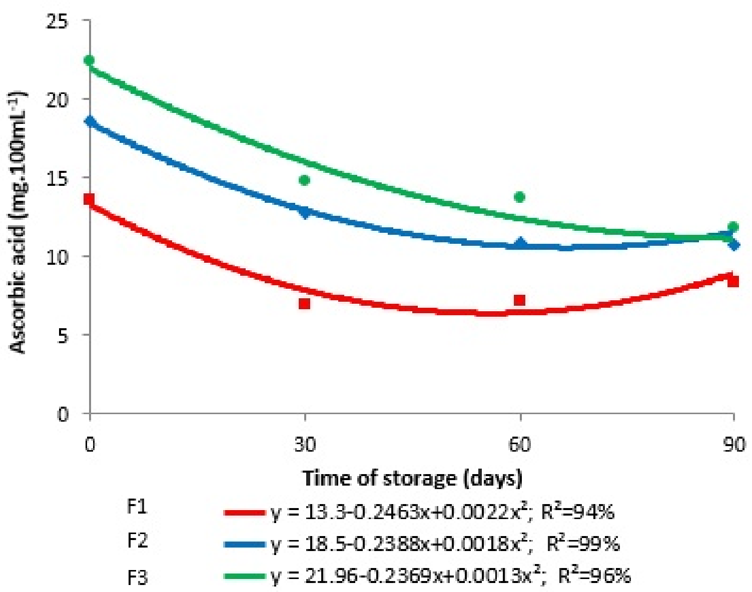

Figure 2. Regression analysis of ascorbic acid levels of uvaia nectar formulations stored at room temperature.

The phenolic compounds levels were higher (48.7%) in the freshly prepared nectar formulations F2 and F3. An increase in the concentration of these compounds was observed after 30 days of storage for all formulations, with higher levels for the nectar with the addition of 50% of uvaia pulp (F3). After 60 days of storage, a reduction of the phenolic compounds levels was observed, with a sharp reduction at day 90, with no difference among the formulations (Table 5, Figure 3).

The regression analysis showed that the phenolic compounds levels were higher at days 33, 26, and 33 of storage for the formulations F1, F2, and F3, with values of 296.68, 444.88, and 563.98 mg gallic acid 100 mL^{-1}, respectively. After these periods, the concentration of phenolic compounds reduced significantly, with a 98% reduction at 90 days of storage (Figure 3). Probably the increase in the phenolic compounds levels on the 30^{th} day was due to the release of these compounds from the uvaia pulp during storage.

Phenolic compounds have antioxidant activity and can act in the sequestration of free radicals, thus contributing to the reduction of oxidative stress and the prevention of chronic diseases (Lagha-Benamrouche & Madani, 2013; Lopes et al., 2018). The present results indicated that the nectar must be consumed until 30 days of storage for the best use of these compounds. In contrast, a reduction of ascorbic acid concentrations was observed throughout 30 days of storage, with a tendency for stability after this period. Maeda et al. (2006) pointed out that some naturally-occurring compounds in fruits, such as flavonoids, can reduce the ascorbic acid degradation. These compounds can act in the complexation of metal ions and as a receptor for free radicals, reducing the oxidation of ascorbic acid. Thus, we believe that some phenolic compounds may have led to a reduction of oxidation reactions, promoting the stability of ascorbic acid after 30 days of storage.

Table 5. Mean total phenolic compounds levels and analysis of variance of uvaia nectar formulations throughout the storage.

Formulations	Time of storage (days) Phenolic compounds (mg gallic acid 100 mL^{-1})			
	0	30	60	90
F1	182.3 ± 17.5^{b}	344.9 ± 38.7^{c}	180.0 ± 18.5^{c}	8.9 ± 0.6^{a}
F2	357.9 ± 67.7^{a}	488.8 ± 9.1^{b}	270.4 ± 42.2^{b}	9.4 ± 0.4^{a}
F3	352.6 ± 18.5^{a}	606.7 ± 55.5^{a}	392.4 ± 44.7^{a}	7.2 ± 1.1^{a}

Means followed by the same letter do not differ by Tukey's test ($p \geq 0.05$). Different superscript letters indicate significant differences among the formulations for the same time of storage. F1 = 30% of uvaia pulp; F2 = 40% of uvaia pulp; F3 = 50% of uvaia pulp.

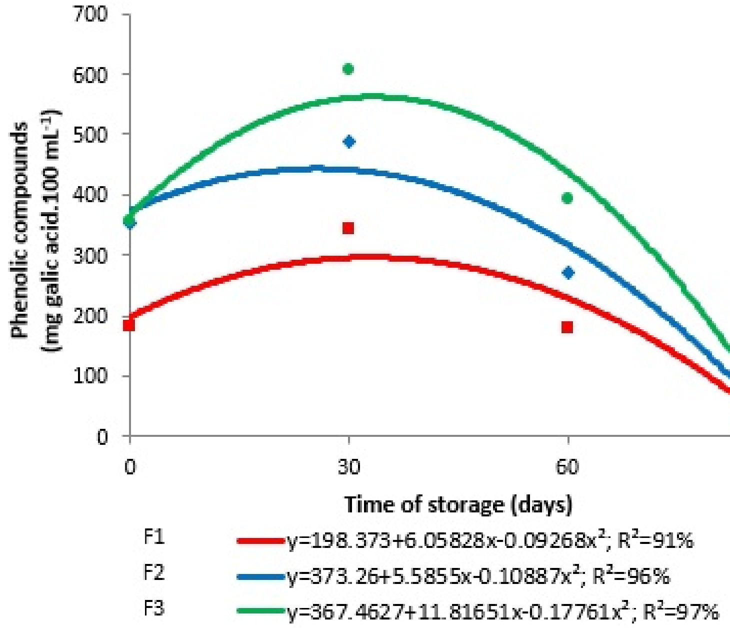

Figure 3. Regression analysis of the phenolic compounds concentration of uvaia nectar formulations stored at room temperature.

4 Conclusions

The nectar formulations containing 40% and 50% of uvaia pulp showed higher concentrations of ascorbic acid and phenolic compounds and better stability during the storage. For better use of these compounds, the nectar must be consumed in approximately 30 days of storage when stored at room temperature. The present study showed that uvaia has great technological and nutritional potential, and can contribute to the development of innovative beverages, with important sources of nutrients and bioactive compounds.

References

Associação Brasileira das Indústrias de Refrigerantes e de Bebidas Não Alcoólicas – ABIR. (2020, June 29). *Néctares e sucos prontos*. Retrieved in 2020, August 05, from http://abir.org.br/o-setor/dados/nectares/.

Bedetti, S. F., Cardoso, L. M., Santos, P. R. G., Dantas, M. I. S., & Pinheiro-Sant'Ana, H. M. (2013). Néctar de cagaita (*Eugenia dysenterica* DC.): Desenvolvimento, caracterização microbiológica, sensorial, química e estudo da estabilidade. *Boletim do CEPPA, Curitiba*, *31*(1), 125-138.

Daud, Z. A. M., Ismail, A., & Sarmadi, B. (2016). Ascorbic acid: physiology and health effects. In B. Caballero, P. M. Finglas & F. Toldrá (Eds.), *Encyclopedia of food and health* (pp. 266-274). Amsterdam: Elsevier. http://dx.doi.org/10.1016/B978-0-12-384947-2.00045-3.

Ferreira, D.F. (2000, Julho). Análises estatísticas por meio do Sisvar para Windows versão 4.0. In RBras (Ed.), *45ª Reunião Anual da Região Brasileira da Sociedade internacional de Biometria* (pp. 255-258). São Carlos: UFSCar.

Folin, O., & Ciocalteu, V. (1927). On tyrosine and tryptophane determinations in proteins. *The Journal of Biological Chemistry, Bethesda*, 73(2), 627-650, https://developmentalbiology.wustl.edu/wp-content/uploads/2018/10/Folin_1927-2553row.pdf.

Gomes, P. (2012). Fruticultura brasileira (13. ed.). São Paulo: Nobel.

Instituto Adolfo Lutz (2008). *Métodos físico-químicos para análise de alimentos* (4. ed.). São Paulo: Instituto Adolfo Lutz. Retrieved in 2020, August 05, from http://www.ial.sp.gov.br/resources/editorinplace/ial/2016_3_19/analisedealimentosial_2008.pdf.

Kuskoski, E. M., Asuero, A. G., Morales, M. T., & Fett, R. (2006). Frutos tropicais silvestres e polpas de frutas congeladas: atividade antioxidante, polifenóis e antocianinas. *Ciência Rural*, *36*(4), 1283-1287. http://dx.doi.org/10.1590/S0103-84782006000400037.

Lagha-Benamrouche, S., & Madani, K. (2013). Phenolic contentes and antioxidante activity of Orange varieties (Citrus sinensis L. and Citrus aurantium L.) cultivated in Algeria: Peels and Leaves. *Industrial Crops and Products*, *50*, 723-730. http://dx.doi.org/10.1016/j.indcrop.2013.07.048.

Lopes, J. M. M., Lage, N. N., Guerra, J. F. C., Silva, M., Bonomo, L. F., Paulino, A. H. S., Regis, A. L. R. S., Pedrosa, M. L., & Silva, M. E. (2018). A preliminar exploration of the potential of Eugenia *uvalha* Cambess juice intake to counter oxidative stress. *Food Research International*, *105*, 563-569. PMid:29433248. http://dx.doi.org/10.1016/j.foodres.2017.11.067.

Maeda, R. N., Pantoja, L., Yuyama, L. K. O., & Chaar, J. M. (2006). Determinação da formulação e caracterização do néctar de camu-camu (*Myrciaria dúbia McVaugh*). *Food Science and Technology*, *26*(1), 70-74. http://dx.doi.org/10.1590/S0101-20612006000100012.

Maeda, R. N., Pantoja, L., Yuyama, L. K. O., & Chaar, J. M. (2007). Estabilidade de ácido ascórbico e antocianinas em néctar de camu-camu (Myrciaria dúbia (H. B. K.) McVaugh. *Food Science and Technology*, *27*(2), 313-316. http://dx.doi.org/10.1590/S0101-20612007000200018.

Massager, P. R. (2005). *Microbiologia dos processos alimentares*. São Paulo: Varela.

Matsuura, F. C. A. U., & Rolim, R. B. (2002). Avaliação da adição de suco de acerola em suco de abacaxi visando à produção de um “blend” com alto teor de vitamina C. *Revista Brasileira de Fruticultura*, *24*(1), 138-141. http://dx.doi.org/10.1590/S0100-29452002000100030.

Mattietto, R. A., Lopes, A. S., & Menezes, H. C. (2007). Estabilidade do néctar misto de cajá e umbu. *Food Science and Technology*, *27*(3), 456-463. http://dx.doi.org/10.1590/S0101-20612007000300006.

Morzelle, M. C., Souza, E. C., Assumpção, C. F., & Boas, B. M. V. (2011). Desenvolvimento e avaliação sensorial de néctar misto de maracujá (*Passiflora edulis Sims*) e araticum (*Annona crassiflora*). *Revista Brasileira de Produtos Agroindustriais*, *13*(2), 131-135. http://dx.doi.org/10.15871/1517-8595/rbpa.v13n2p131-135.

Neves, L. C., Benedette, R. M., Tosin, J. M., Chagas, E. A., Silva, V. X., Prill, M. A. S., & Roberto, S. R. (2011). Produção de blends a partir de frutos tropicais e nativos da Amazônia. *Revista Brasileira de Fruticultura*, *33*(1), 187-197. http://dx.doi.org/10.1590/S0100-29452011005000023.

Reitz, P., Klein, R. M., & Reis, A. (1988). *Projeto madeira do Rio Grande do Sul.* Porto Alegre: Secretaria da Agricultura e Abastecimento.

Rufino, M. S. M., Alves, R. E., de Brito, E. S., Pérez-Jiménez, J., Saura-Calixto, F., & Mancini-Filho, J. (2010). Bioactive compounds and antioxidante capacities of 18 non-traditional tropical fruits from Brazil. *Food Chemistry*, *121*(4), 996-1002. http://dx.doi.org/10.1016/j.foodchem.2010.01.037.

Scalon, S. P. Q., Dell’Olio, P., & Fornasieri, J. L. (2004). Temperatura e embalagens na conservação pós-colheita de Eugenia uvalha Cambess - Mirtaceae. *Ciência Rural*, *34*(6), 1965-1968. http://dx.doi.org/10.1590/S0103-84782004000600048.

Silva, M. R., Lacerda, D. B. C. L., Santos, G. G., & Martins, D. M. O. (2008). Caracterização química de frutos nativos do cerrado. *Ciência Rural*, 38(6), 1790-1793. http://dx.doi.org/10.1590/S0103-84782008000600051.

Silva, L. M. R., Figueiredo, E. A. T., Ricardo, N. M. P. S., Vieira, T. G. P., Figueiredo, R. W., Brasil, I. M., & Gomes, C. L. (2014). Quantification of bioactive compounds in pulps and by-products of tropical fruits from Brazil. *Food Chemistry*, 143, 398-404. https://doi.org/10.1016/j.foodchem.2013.08.001.

Souza Filho, M. S. M., Lima, J. R., Nassu, R. T., Borges, M. F., & Moura, C. F. H. (2002). Nota prévia: Avaliação físico-química e sensorial de néctares de frutas nativas da região norte e nordeste do Brasil: Estudo exploratório. *Brazilian Journal of Food Technology*, 5, 139-143, http://bjft.ital.sp.gov.br/arquivos/artigos/v5nu091a.

Sousa, Y. A., Borges, M. A., Viana, A. F. S., Dias, A. L., Sousa, J. J. V., Silva, B. A., Silva, S. K. R. S., & Aguiar, F. S. (2020). Avaliação físico-química e microbiológica de polpas de frutas congeladas comercializadas em Santarém-PA. *Brazilian Journal of Food Technology*, 23, 1-10, https://www.scielo.br/pdf/bjft/v23/1981-6723-bjft-23-e2018085.

Tomaz, K. S., Ferreira, M. R. S., Mesquita, M. S., & Oliveira Filho, J. H. (2019). Physicochemical and microbiological stability of mixed néctar of Orange and uvaia. *Ciência Rural*, 7(49), 1-8, https://www.scielo.br/pdf/cr/v49n7/1678-4596-cr-49-07-e20180917.

Zillo, R. R., Silva, P. P. M., Zanatta, S., & Spoto, M. H. F. (2014). Parâmetro físico-químicos e sensoriais de polpa de uvaia (*Eugenia Pyriformis*) submetidas à pasteurização. *Bioenergia em Revista: Diálogos*, 4(2), 20-33, http://fatecpiracicaba.edu.br/revista/index.php/bioenergiaemrevista/article/view/133/83.

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