Chemical and sensorial analysis of blueberry nectar and juice

Dianini Brum Frölech[1,*], Adriane Marinho de Assis[1], Márcia Wulff Schuch[1], Maria Inez Lopes Fernandes de Barros[1], Michele Carla Nadal[2] and Bruna Andressa dos Santos Oliveira[1]

[1]Universidade Federal de Pelotas, Departamento de Fitotecnia, Pelotas, RS, Brazil. [2]Universidade Federal de Lavras, Departamento de Agricultura, Lavras, MG, Brasil. Corresponding author: dianinifrolech.enologia@gmail.com

ABSTRACT

Blueberry (*Vaccinium* spp.), much appreciated for its exotic flavor and nutraceutical properties, can be consumed *in natura* and in beverages such as nectar and juice. The aim of this study was to evaluate the chemical characteristics and the acceptance of commercial nectar and blueberry juice elaborated by the steam dragging method. The work was carried out in August of 2016, at the Universidade Federal de Pelotas, Pelotas (RS). The experimental design was in a uniform scheme, with two levels: commercial nectar and juice elaborated with the combination of fruits of cultivars Bluegem and Powderblue. Soluble solids content, titratable acidity and the pH of the samples were evaluated. For the sensorial analysis, a panel of fifty-five judges evaluated attributes such as color, aroma, flavor, body and global acceptance, using a nine-point hedonic scale. Regarding the chemical analyzes, there was a statistical difference for total soluble solids content and the nectar showed the highest content. In the sensory analysis, the juice elaborated with 'Bluegem' and 'Powderblue' obtained the highest mean for color, while for the flavor and body attributes, the preference of the judges for the nectar was verified. However, both had good overall acceptance, with scores between 7.52 and 7.62. Thus, acceptance of both nectar and juice was considered satisfactory by the evaluators.

Key words: *Vaccinium* spp., acceptance test, processing, small fruits.

INTRODUCTION

Blueberries belong to the *Ericaceae* family and are native of Europe and the US, where they are much appreciated for their exotic flavor, economic value, being also widely disseminated as a source of longevity, due to their nutritional composition (Antunes and Raseira 2006).

According to Morazzoni and Bombardelli (1996), the fruit has vitamins A, B, C, K, plus folic acid, calcium, iron, phosphate, magnesium, manganese, potassium, sugars, pectin, tannin, citric, malic and tartaric acid and resveratrol. It also stands out for the high content of polyphenols, both in the peel and in the pulp (Payne 2005; Deng et al., 2014).

In countries from the Northern Hemisphere, mainly in Europe and in the US, this fruit species is largely cultivated. In Brazil, it was introduced in 1983, together with a collection of plants brought by the Embrapa Center for Temperate Climate Agricultural Research, and the first commercial initiative took place in 1990, in Vacaria, RS (Fachinello 2008). However, the increase in cultivated areas and the good commercialization price contributed to increase the interest of Brazilian growers, who had the opportunity to harvest the fruit during the offseason in countries traditionally known as consumers and growers (Brackmann et al., 2010).

Among the alternatives for the commercialization of blueberry, is the fruit *in natura*. However, one of the greatest bottlenecks is its high perishability, even under refrigeration (Pelegrini et al., 2012), which highlights the importance of the other possibilities of its insertion in the market, which, according to Kechinski (2011) are the fruit byproducts such as yogurts, ice creams, jams, juices and nectars.

Considering that its unique flavor and color are attractive factors for the consumer (Hoffmann and Antunes 2016), beverages prepared with blueberry can become promising options. According to Guerra (2016), in the last couple of years, the media and the popular movement towards the consumption of healthy beverages led to a considerable increase in the production and consumption of the juice.

Decree 6.871 of June 6 2009, which regulates law 8.918, of July 14, 1994, defines nectar as a fermented beverage obtained through dilution in drinking water of the eatable part of a vegetable or its extract, added by sugars, destined to consumption. The juice, on the other hand, is a non-fermented beverage, obtained

from a ripe and healthy fruit or part of the original vegetal through adequate technological processing, submitted to treatment that guarantees its presentation and preservation until the moment of consumption (Ministério da Agricultura 2009). One of the juice production methods is the steam dragging, with extracting-pans, highly used in small-scale productions, mainly in small rural properties (Guerra 2016). Despite the advantages, this technique implies in some incorporation of water to the juice (Bresolin et al., 2013).

Kechinski (2011) described that among the blueberry byproducts, the juice is the most important. Therefore, regardless of the type of beverage, it is extremely important to determine their chemical characteristics. Acceptance as well as the consumers' preference regarding the products should also be evaluated, being the hedonic scale a widely used method (Della Torre et al., 2003; Borges et al., 2011; Koyama et al., 2015), due to its reliability and results validity, as well as for being simple to use by evaluators (Villanueva et al., 2005).

Since information on the blueberry nectar and juice obtained by the Bluegem and Powderblue cultivars are scarce, the objective of this work was to evaluate the chemical characteristics and acceptance of a commercial nectar and blueberry juice prepared by the steam-dragging method.

MATERIAL AND METHODS

This work was developed in August 2016 at Faculdade de Agronomia Eliseu Maciel, Pelotas Universidade Federal de Pelotas (UFPel), located in the county of Capão do Leão-RS.

The study analyzed two types of beverages made of blueberry nectar and juice, constituting a one-way Anova of two levels. The nectar was a registered commercial product purchased at the local commerce in Pelotas-RS, made of water, 50% of juice, sugar, natural aroma and antioxidant. The juice was prepared with 3 kg of blueberry fruit mix from the Bluegem and Powderblue cultivars (in the proportion of 1:1), collected from a commercial production area located in Pelotas, RS, during the harvest of 2016. Firstly, the fruit were washed in running water and then the juice was extracted by the steam dragging process, using an extracting pan, with capacity for 18 kg. After the extraction, the juice was bottled still warm in glass bottles of 750 mL. Then it was stored in the refrigerator at ±10°C, for analysis.

The chemical analysis was realized at LabAgro/Fruticultura from the Agronomy Graduate Program at UFPel. Assessments included the pH determined by a pH meter from the brand Quimis®; total soluble solids (SST), using a portable refractometer with the result expressed in °Brix; and titratable acidity (TA), by the titration method, using 10 mL of sample diluted in 90 mL of distilled water. Titration made with solution of NaOH 0.1N, until reaching pH 8.2 was also assessed, being the results expressed in citric acid percentage (Instituto Adolfo Lutz 1985).

A questionnaire was applied to 55 untrained individuals, including students, teachers and employees of UFPel, to assess the evaluators' profile. Through this questionnaire, age group, occupation, education, preference and frequency of blueberry juice consumption were evaluated. Data were presented according to gender (male and female).

Next, a sensorial analysis of the blueberry nectar and juice was carried out in individual booths at the UFPel Sensorial Analysis Laboratory. Attributes such as color, aroma, flavor, body and global acceptance of the samples were evaluated, using a nine-point hedonic scale from dislike extremely (1) to like extremely (9) (Table 1) (Villanueva et al., 2005). Samples with 20 mL of the nectar and juice each were served at 10°C, in transparent polyethylene cups. Each evaluator received the two samples, coded with randomized three-digit numbers (Figures 2A and 2B). Evaluators rinsed their mouth with mineral water at room temperature before and between evaluations. A randomized blocks experimental design was used and data submitted to an analysis of variance by the F test ($p<0.05$). The effects of determined statistical significance were compared by the t test ($p\leq0.05$).

Table 1. Blueberry nectar and juice samples: evaluation form.

Hedonic Scale of Attributes

NAME: _____ DATE: _____

Evaluated each coded sample, **from left to right.** Use the scale below to show how much you **liked or disliked** each attribute (color, aroma, flavor, body and global acceptance).

9 – Like extremely
8 –
7 –
6 –
5 – Neither like nor dislike
4 –
3 –
2 –
1 – Dislike extremely

Samples	**number:**	**number:**
Color		
Aroma		
Flavor		
Body		
Global Acceptance		

Comments:
_____
_____

RESULTS AND DISCUSSION

In regards to the chemical characteristics, nectar solid soluble contents showed higher mean, differing statistically from the juice obtained by the steam-dragging method (Table 2). Such fact occurred, probably, due to the concentration of sugar added to the commercial product formulation, while the juice obtained by the steam-dragging method had only sugar originated from the fruit itself.

Table 2. Blueberry nectar and juice chemical characteristics by the steam dragging method. Pelotas, RS. 2016.

Samples	**Soluble Solids (°Brix)**	**pH**	**Titratable Acidity (g.100mL^{-1} ac citric)**
Nectar	12.5 a[1]	3.48 ^{NS}	0.45 ^{NS}
Juice	9.0 b	3.46	0.52
C.V. (%)	0.5	1.6	8.1

[1]Means followed by the same letter in the column do not differ among themselves by the t test ($p<0.05$). ^{NS}: non-significant by the F test ($p<0.05$) of the analysis of variance. C.V. (%): coefficient of variation.

The value registered for the juice prepared by the steam-dragging method was superior to that described by Kechinski (2011) who obtained 8.0 °Brix from blueberry juice prepared by the same method. On the other hand, during the evaluation of the fruit *in natura*, the value found by Pelegrine et al. (2012) was 10.0 °Brix, i.e., smaller than the value found for the nectar and greater when compared to the blueberry juice prepared by the steam-dragging method in this experiment. According to Normative Instruction 19 of June 19, 2013, soluble solids minimum content established for blueberry juice is 10 °Brix (Ministério da Agricultura 2013).

In regards to the pH, there was no significant difference between the products evaluated (Table 2). Contents were superior to those verified by Concenço et al. (2014), who registered values of 3.27 and 3.33 for blueberry pulp and extract, respectively.

As for titratable acidity, there was no significant difference between the analyzed products (Table 2). Acidity contents were superior to those observed by Kechinski (2011), who obtained 0.32%. However, it was inferior to those reported by Pelegrine et al. (2012), who registered 0.64% and 0.72%, respectively for *in natura* blueberry. Oliva (2002), in a sensorial analysis experiment with pasteurized juice from sweet orange (*Citrus sinensis*) cultivars concluded that intense acidity is an attribute of less acceptance by the evaluators.

Sensorial acceptance test results for nectar and juice regarding color, aroma, flavor, body and global acceptance are described in Table 3.

Table 3. Mean for attributes such as color, aroma, flavor, body and global acceptance of blueberry nectar and juice prepared by the steam dragging method Pelotas, RS. 2016.

Samples	Attributes				
	Color	Aroma	Flavor	Body	Global Acceptance
Nectar	6.23 b[1]	7.64 [NS]	7.63 a	7.60 a	7.52[NS]
Juice	8.62 a	7.38	6.75 b	6.62 b	7.62
C.V. (%)	17.5	17.9	13.6	14.1	13.6

[1]Means followed by the same letter in the column do not differ among themselves by the t test ($p<0.05$). [NS] non-significant by the F test ($p<0.05$) of the analysis of variance. C.V. (%): coefficient of variation.

In regards to color, there were significant differences between the two samples (Table 3). For this attribute, the juice sample showed the highest mean obtained through the steam dragging method. When evaluating orange juice prepared with different cultivars, Oliva (2002) reported that color is one of the most important aspects regarding appearance and product acceptance. In addition, Kechinski (2011) mentioned that color is an attribute perceived as an indicator of quality and, many times, determines the decision to purchase a product, while Dutra et al. (2014) reported that the high color intensity could be a determining characteristic in juice acceptance.

As for aroma, there were no significant differences between the samples (Table 3). According to Jordão (2005), the aroma is a complex attribute since it is related to several volatile substances belonging to different chemical classes.

There were statistical differences between the samples in regards to flavor and body, with the nectar showing the highest mean (Table 3). However, the values registered for the two types of beverages were between 6.62 and 7.63, indicating satisfactory acceptance. Pontes et al. (2010), evaluated the acceptance of a commercial grape nectar and juice and observed that the integral juice containing only natural fruit had the same acceptance as the nectar with the addition of sugar. In the present study, although the juice prepared with the mix 'Bluegem' and 'Powderblue' fruit had fruit sugar, the incorporation of water to the juice during the extraction by steam dragging led to juice dilution and, consequently, to less total soluble solids content, which may have interfered in the acceptance by the evaluators in relation to flavor.

In regards to global acceptance, the juice prepared by the steam dragging method showed a higher mean, with no significant difference from the nectar. Hedonic scale grades varied between 7.52 and 7.62, indicating good acceptance of the analyzed juices by the evaluators. Dutra et al. (2014), in a study with grape juice, warned about the importance of taking into account the preference of the consumer for the cultivar, since the diversity of habits leads to the use of cultivars with very distinct flavor characteristics. In

addition, Borges et al. (2011), during the sensorial analysis of grape juice 'Isabel', stressed the need to consider product acceptance by the consumers to prevent the risk of causing financial damages to the sector.

Figure 1 shows the results from the evaluators' profiles assessment in regards to age group, occupation, education, preference and frequency of juice consumption. As for the age group, the predominant age varied from 15 to 25 years of age (Figure 1A) and most evaluators were females.

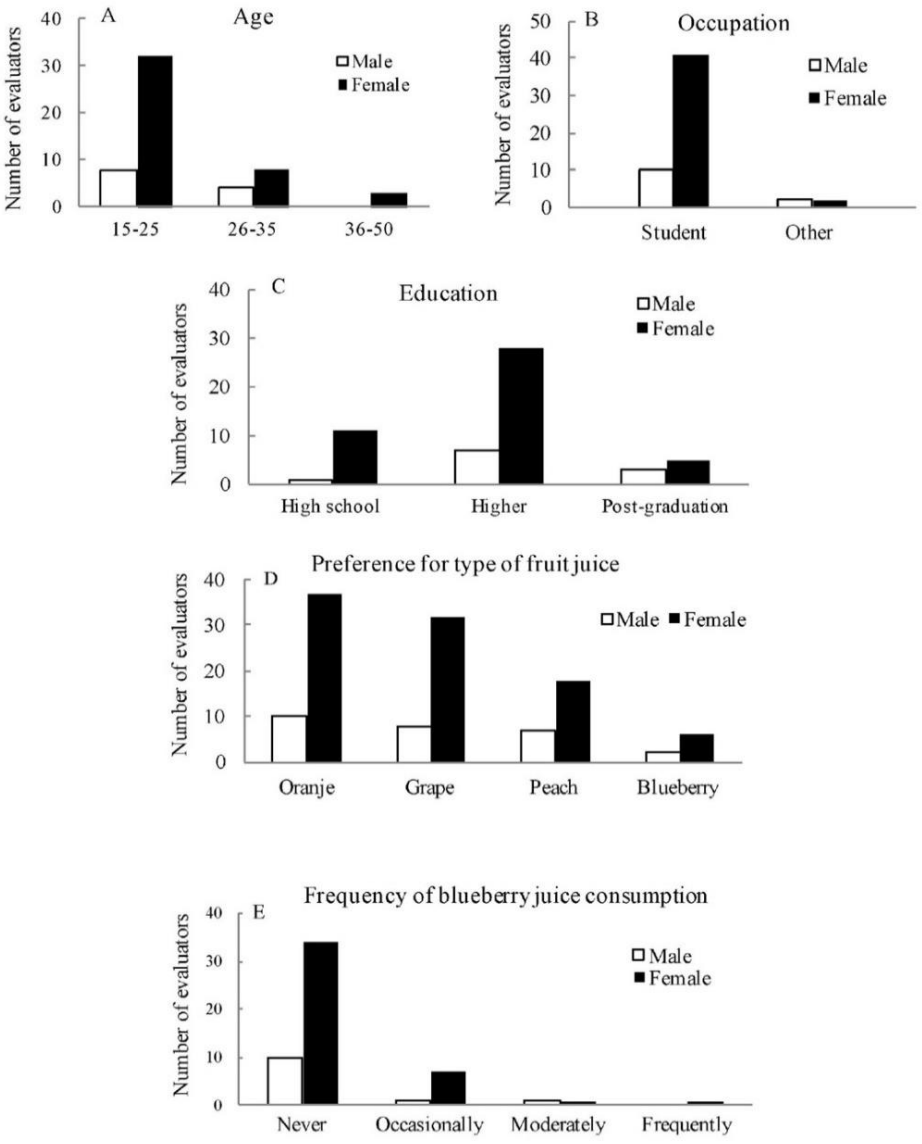

Figure 1. Results of the evaluators' profiles in regards to age (A); occupation (B); education(C); preference for type of fruit juice (D); and frequency of blueberry juice consumption (E). Obs.: Occasionally: at least once a year. Moderately: at least once a month. Frequently: at least once a week. Pelotas, RS. 2016.

In regards to occupation, most evaluators were students (Figure 1B). As for education level, most had higher education (Figure 1C). The second level of education for the male evaluators was post-graduation, while for female evaluators was a high school degree.

As for preference for type of fruit juice, most evaluators chose orange and grape juice (Figure 1D) and, in this case, they were instructed to choose one more type. Borges et al. (2011) obtained similar results in an experiment with the grape juice 'Isabel', using cuts from different cultivars. Koyama et al. (2015) also presented the same results in a work with the grape juice 'Isabel', whose grapes were submitted to an application of abscisic acid, in which the orange and grape juices had the highest preference among the evaluators.

In regards to the frequency of blueberry juice consumption, most evaluators had never consumed this type of juice before (Figure 1E). Female consumers showed to be the greatest occasional consumers (at

least once a year) of this juice, and no male evaluator said they consume the juice frequently (at least once a week). The fact that the blueberry juice is not among the most consumed juices can be related to its low availability in the market as well as to the need for greater dissemination.

Oliva (2002) stresses that carrying out a sensorial quality evaluation of food is not an easy task for being a complex response to the product sensorial properties, which is based on the individual's expectations, preferences and previous experiences in relation to the product. However, as the consumer's preference for natural and healthy foods is growing around the world, results from the present study shows that the hedonic means for all evaluated attributes were between 6,2 and 8.66, indicating the consumption potential of the analyzed blueberry nectar and juice.

In summary, although the nectar shows greater total soluble content, the juice prepared with the 'Bluegem' and 'Powderblue' fuit mix stood out in regards to color, an essential attribute for commercialization and showed no significant difference in regards to global acceptance. Therefore, considering that the juice made with these two cultivars has only the fruit in its composition, i.e, it does not include sugar or other additives, it can be a promising alternative for the preparation of the juice by the steam dragging method. However, more research on this subject must be realized to evaluate other cultivars, other methods of extraction, as well as to motivate fruit juice consumers to consume beverages prepared with blueberry.

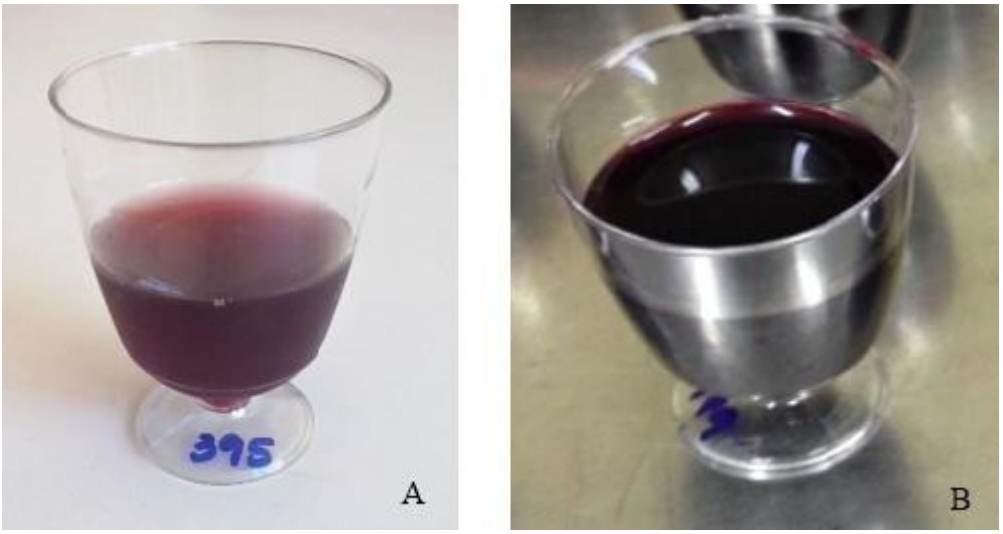

Figure 2. 'Bluegem' and 'Powderblue' nectar (A) and juice (B) served to the evaluators.

CONCLUSION

Blueberry nectar and juice prepared by a 'Bluegem' and 'Powderblue' fruit mix, using the steam ragging method, showed satisfactory sensorial acceptance.

ACKNOWLEDGEMENT

To CAPES (*Coordination for the Improvement of Higher Education Personnel*) and CNPq (National Council for Scientific and Technological Development) for granting a scholarsip.

To Instituto Federal Sul-rio-grandense, *Campus* Pelotas - Visconde da Graça (CaVG), and to Dr. Márcia Arocha Gularte, professor at Faculdade de Agronomia Eliseu Maciel- UFPel, for her collaboration during the realization of this research.

REFERENCES

Antunes LEC and Raseira MCB (2006) Cultivo do mirtilo (*Vaccinium* spp). Embrapa Clima Temperado, Pelotas, 98p.

Borges RS, Prudencio SH, Roberto SR and Assis AM (2011) Avaliação sensorial de suco de uva cv. Isabel em cortes com diferentes cultivares. Revista Brasileira de Fruticultura 33: 584-591.

Brackmann A, Weber A, Giehl RFH, Eisermann AC, Sautter CK, Gonçalves ED and Antunes LEC (2010) Armazenamento de mirtilo 'Bluegem' em atmosfera controlada e refrigerada com absorção e inibição do etileno. Revista Ceres 57: 06-011.

Bresolin B, Gularte MA and Manfroi V (2013) Água exógena em suco de uva obtido pelo método de arraste de vapor. Revista Brasileira de Tecnologia Agroindustrial 7: 922-933.

Concenço FIGR, Stringheta PC, Ramos AM, Oliveira IHT and Leone RS (2014) Caracterização e avaliação das propriedades físico-químicas da polpa, casca e extrato de mirtilo (vaccinium myrtillus). Revista Brasileira de Tecnologia Agroindustrial 8: 1177-1187.

Della Torre J, Rodas MAB, Badolato GG and Tadini CC (2003) Perfil sensorial e aceitação de suco de laranja pasteurizado minimamente processado. Ciência e Tecnologia de Alimentos 23: 105-111.

Deng Y, Yang G, Yue J, Qian B, Liu Z, Wang D, Zhong Y and Zhao Y (2014) Influences of ripening stages and extracting solvents on the polyphenolic compounds, antimicrobial and antioxidant activities of blueberry leaf extracts. Food Control 38: 184-191.

Dutra MCP, Lima MS, Barros APA, Mascarenhas RJ and Lafisca A (2014) Influência da variedade de uvas nas características analíticas e aceitação sensorial do suco artesanal. Revista Brasileira de Produtos Agroindustriais 16: 265-272.

Fachinello JC (2008) Mirtilo. Revista Brasileira de Fruticultura 30: 285-288.

Guerra CC (2016) Sistema para elaboração de suco de uva integral em pequenos volumes: suquificador integral. Embrapa Uva e Vinho, Bento Gonçalves, 32p.

Hoffmann A and Antunes LEC (2016) Como cultivar mirtilo. http://www.cnpuv.embrapa.br/publica/artigos/como_cultivar_mirtilo.pdf. Acessado em 23 de agosto de 2017.

Instituto Adolfo Lutz (1985) Normas analíticas do Instituto Adolfo Lutz: métodos químicos e físicos para análise dos alimentos. Instituto Adolfo Lutz, São Paulo, 371p.
Jordão FG (2005) Perfil sensorial e aceitabilidade de suco de laranja integral pasteurizado e suco de laranja reconstituído. Dissertação, Universidade de São Paulo.

Kechinski CP (2011) Estudos de diferentes formas de processamento do mirtilo visando à preservação dos compostos antociânicos. Tese, Universidade Federal do Rio Grande do Sul.

Koyama R, Assis AM, Yamamoto LY, Prudencio SH and Roberto SR (2015) Análise sensorial do suco integral de uva 'Isabel' submetida à aplicação de ácido abscísico. Revista Brasileira de Fruticultura 34: 893-901.

Ministério da Agricultura (Brasil) (2013) Instrução Normativa n° 19, de 19 de junho de 2013. http://www.sucodeuvadobrasil.com.br/legislacao/instrucao_normativa_no_19_de_19_de_junho_de_2013___pic_bebidas_n_alcoolicas.pdf. Acessado em 27 de agosto de 2017.

Ministério da Agricultura (Brasil) (2009) Decreto 6.871, de 6 de junho de 2009. http://extranet.agricultura.gov.br/sislegis-consulta/consultarLegislacao.do?operacao= visualizar&id=20271. Acessado em 26 de agosto de 2017.

Morazzoni P and Bombardelli E (1996) *Vaccinium Myrtillus* L. Revista Fitoterapia 67: 3-29.

Oliva BP (2002) Influência das variedades cítricas (*Citrus sinensis L. Osbeck*) natal, perario e valência na qualidade do suco de laranja pasteurizado. Dissertação, Universidade Estadual de Campinas.

Payne TJ (2005) Formulating with Blueberries for Health. Cereal Foods World 50: 262-264.

Pelegrine DHG, Alves GL, Querido AF and Carvalho JG (2012) Geleia de mirtilo elaborada com frutas da variedade Climax: desenvolvimento e análise dos parâmetros sensoriais. Revista Brasileira de Produtos Agroindustriais 14: 225-231.

Pontes PRB, Santiago SS, Szabo TN, Toledo LP and Gollücke APB (2010) Atributos sensoriais e aceitação de sucos de uva comerciais. Ciência e Tecnologia de Alimentos 30: 313-318.

Villanueva NDM, Petenate AJ and Silva MAAP (2005) Perfomance of hibrid hedonic scale as compared to the traditional hedonic, self-adjusting and ranking scales. Food Quality and Preference 16: 691-703.

Received: November 5, 2018.
Accepted: February 22, 2019.
Published: June 28, 2019.