Exploratory analysis of the sensory attributes of american grape juice blends

Maria Aparecida da Cruz[1,*], Deived Uilian de Carvalho[1], Ronan Carlos Colombo[1], Luiz Henrique Tutida Yokota[1], André Luis Silva[1], Helio Fernandes Ibanhes Neto[1] and Sergio Ruffo Roberto[1]

[1]Universidade Estadual de Londrina, Departamento de Agronomia, CP 6001, CEP 86051-970, Londrina, PR, Brazil. *Corresponding author, E-mail: mary_ac18@hotmail.com

ABSTRACT

Grape juices are blended in order to balance the organoleptic characteristics of juice, as well as to reduce off-season costs. The aim of this study was to evaluate the acceptance of consumers, through sensory analysis, of 'Bordô', 'Niagara Rosada', 'BRS Nubia' and 'Isabel' grape juices and their blends. The experiment was conducted during two periods. In the first, the grape juices analyzed were: 'Niagara Rosada' 100%, 'Bordô' 100%, 'Isabel' 100%, 'Isabel' 90% + 'Bordô' 10% and 'Isabel' 80% + 'Bordô' 20%. In the second, the following juices were evaluated: 'Bordô' 100%, 'Niagara Rosada' 100%, 'Bordô' 75% + 'Niagara Rosada' 25%, 'Bordô' 50% + 'Niagara Rosada' 50%, 'Bordô' 25% + 'Niagara Rosada' 75% and 'BRS Nubia' 100%. The juices were obtained by the 'Welch' process by steam entrainment. For the sensory evaluation, six tasters evaluated the following attributes in each period: color, aroma, flavor, body and overall acceptability, using a 7-point hedonic scale. The 'Niagara Rosada' juice 100% presents low acceptance, while the 'Bordô' and 'Niagara Rosada' juices up to 1:1 (v:v) show high acceptance, as well as 'Bordô' and 'Isabel' blends, confirming the importance of 'Bordô' juice for grape juice blends. The 'Nubia' juice 100% may be an alternative for grape juice blends due to its intense color.

Key words: 'Welch' process, acceptance test, *Vitis labrusca* L., grape juice blends.

INTRODUCTION

Grape juice is an unfermented drink obtained from the grape must of healthy and mature grapes. It has both sweet and acidic flavor at the same time, high amounts of sugars, organic acids and minerals. In addition, it presents nutraceutical properties, vitamins and phenolic compounds that are beneficial to the development and functions of the human organism (Ministério da Agricultura, Pecuária e Abastecimento 2004; Rizzon and Meneguzzo 2007). Phenolic compounds are also responsible for color, astringency and structure of the juice; anthocyanins, tannins and phenolic acids are the most important of them. The juice aroma derives from volatile compounds, originated from the own grapes (Rizzon and Link 2006).

Moreover, another compound, known as resveratrol, is a natural molecule associated to the grape juice. It has a broad spectrum of health benefits, acting as antioxidant, anti-inflammatory, antiviral, cardioprotective and cancer chemopreventive, and can also retard the aging process (Acaua 2007). The resveratrol concentration in juices can vary according to the cultivar and the type of processing used to formulate the juices (Sautter et al., 2005).

The grape juice can be classified as whole, concentrated, dehydrated or reconstituted, according to the juice constitution and production processes. The whole juice presents natural composition and concentration, where addition of any ingredient is allowed. The concentrated juice is partially dehydrated to 65 °Brix of soluble solids content, while the dehydrated juice is obtained by the dehydration of grape juice to a maximum moisture content of 3%, being presented in solid form. The reconstituted juice is then obtained, diluting the concentrated or dehydrated juice to its natural concentration (Ministério da Agricultura, Pecuária e Abastecimento 2014). Therefore, the grape juice obtained by the 'Welch' process by steam entrainment does not comply with these regulations, and can be classified as a nectar drink. This is due to the addition of 8 to 17% of water to the juice, since there is no other way to separate the steam that goes through the grapes from the juice (Cristófoli et al., 2008a, 2008b). However, about 50.000 family farmers throughout the country produce this type of juice, mostly informally (Guerra 2003).

The main grapes used for juice production in Brazil belongs to the *Vitis labrusca* L. specie, among which 'Bordô', 'Isabel' and 'Niagara Rosada' stand out. However, cultivars developed by EMBRAPA have proved to be suitable for this purpose and for the consumption as table grapes. The 'BRS Nubia', recommended for fresh consumption (Maia et al., 2013), presents characteristics that could be interesting for blend processing and composition, such as high productivity (30 t ha^{-1}) and intense color.

In the grape industry, blends of juices from different grape cultivars are commonly made. The purpose of the blends is to balance the organoleptic characteristics (color, aroma, flavor, body) of the juice and to reduce costs in the off-season. Sensory analysis is an important method used to measure the quality and success of a grape juice, through scientific methods developed to accurately and reproducibly measure human responses to the stimuli (Drake 2007).

The hedonic scale test has been widely used for data collection in sensory analysis, due to its easy application and understanding (Reis and Minin 2006). Thereby, the aim of this study was to evaluate the acceptance of consumers, through exploratory sensory analysis, of 'Bordô', 'Niagara Rosada', 'BRS Nubia' and 'Isabel' grape juices and their blends.

MATERIALS AND METHODS

The experiment was carried out at the Fruit Analysis Laboratory of the Londrina State University - UEL, in Londrina-PR, during two periods. The juices from 'Bordô', 'Isabel', 'Niagara Rosada' and 'BRS Nubia' grapes were prepared using the 'Welch' method. This process consists in extracting the juice by steam entrainment, using a stainless steel extraction pot with a capacity of 7kg, without enzyme addition (Rizzon and Link 2006; Borges et al., 2013).

In the first period, five different grape juices were evaluated: 'Niagara Rosada' 100%, 'Bordô' 100%, 'Isabel' 100%, 'Isabel' 90% + 'Bordô' 10% and 'Isabel' 80% + 'Bordô' 20%. In the second, six juices were evaluated: 'Bordô' 100%, 'Niagara Rosada' 100%, 'Bordô' 75% + 'Niagara Rosada' 25%, 'Bordô' 50% + 'Niagara Rosada' 50%, 'Bordô' 25% + 'Niagara Rosada' 75% and 'BRS Nubia' 100%.

The berries were previously removed from the rachis, eliminating the green and damaged ones that could compromise the juice taste. Then, the berries were washed under water and submitted to the juice extraction. First, the bottom section of the steamer juicer pot was filled with water and heated. The washed grapes from each treatment were placed inside the steamer top section and the lid was put on. After 40 minutes, all the grape juice was drained into the steamer middle section, and then bottled in one-liter sterilized polyethylene containers at warm temperature (80 °C). After cooling, the juice bottles were stored in refrigerator at 4 °C for later blend composition and sensory analysis.

The juice sample soluble solids content (SS) was determined by digital refractometer, and the results were presented in Tables 3 and 4. For the sensory analysis evaluation, the acceptance level for the following attributes were considered: color, aroma, flavor, body and overall acceptability, using a 7- point hedonic scale, which ranged from ''dislike extremely (1)'' to ''like extremely (7)''. The juice samples were served at 4 °C in INAO glasses at a volume of 50 mL per sample (Figure 1). Each taster received the six treatment samples in randomized order. Drinking water, in ambient temperature, was served to the tasters for mouth cleaning before and between the grape juice evaluations.

Figure 1. Juice samples of 'Niagara Rosada' 100%, 'Bordô' 100%, 'Isabel' 100%, 'Isabel' 90% + 'Bordô' 10% and 'Isabel' 80% + 'Bordô' 20%, from right to left, respectively; in INAO glasses at a volume of 50 mL per sample.

Regarding the taster's profile evaluation, a questionnaire was applied to six untrained judges representing the consumers, in each period. The group profile was classified according to the age, level of education and occupation of the interviewees, as well as their fruit juice preference.

The results are presented in radar charts, which allow better visualization of the positive or negative impacts of each attribute from the different grape juices.

RESULTS AND DISCUSSION

In the first evaluation period, greater acceptance was observed for the 'Bordô' juice 100% and its blends with the Isabel cultivar (Table 1, Figure 2). The evaluated attributes from the 'Isabel' juice 100%, reached values close to those attributed to the 'Bordô' + 'Isabel' blends. On the other hand, the 'Niágara Rosada' juice 100% did not obtain a satisfactory acceptance of the attributes analyzed by the tasters, except for the aroma, which was slightly higher than the aroma of 'Isabel' juice 100%.

Table 1. Mean values and corresponding standard deviation of color (CL), aroma (AR), flavor (FV), body (BD) and overall acceptability (OA) in the sensory analysis of different grape juices, in the first evaluation period.

TREATMENTS	CL	AR	FV	BD	OA
Bordô 100%	6.3 ± 0.2	5.5 ± 0.4	6.0 ± 0.4	5.8 ± 0.4	6.0 ± 0.3
Niagara R. * 100%	2.8 ± 0.7	4.0 ± 0.7	2.3 ± 0.6	3.5 ± 0.7	3.2 ± 0.5
Bordô 75%+ Niagara R. 25%	6.3 ± 0.3	5.0 ± 0.6	5.5 ± 0.4	5.7 ± 0.6	5.5 ± 0.3
Bordô 50%+ Niagara R. 50%	5.5 ± 0.4	4.8 ± 0.7	5.5 ± 0.3	5.5 ± 0.5	5.2 ± 0.5
Bordô 25%+ Niagara R. 75%	3.8± 0.4	4.7 ± 0.6	4.5 ± 0.7	4.5 ± 0.7	4.6 ± 0.5
Nubia 100%	6.3 ± 0.3	2.8 ± 0.6	4.3 ± 0.8	4.5 ± 0.5	4.2 ± 0.6

*Niagara R. = Niagara Rosada.

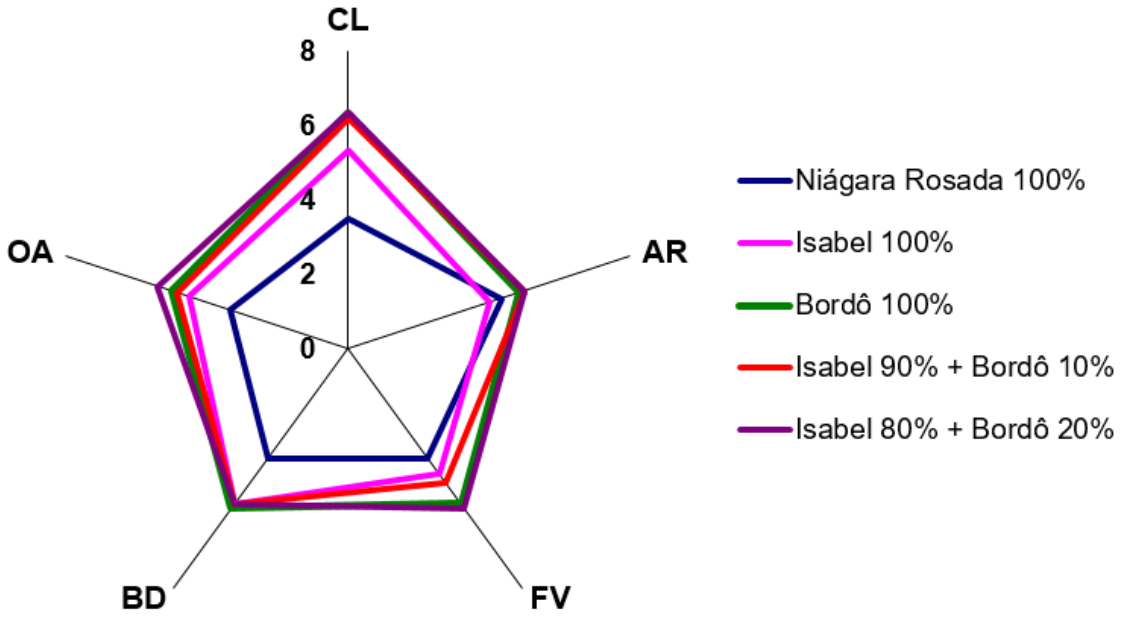

Figure 2. Sensory analysis of different grape juices concerning color (CL), aroma (AR), flavor (FV), body (BD) and overall acceptability (OA), in the first evaluation period.

The 'Niagara Rosada' (100%) and 'Isabel' (100%) juices presented lower grades than other juices for the color attribute, since these grape cultivars have less pigmentation compared to others. Camargo et al. (2010) report that the Isabel cultivar presents coloration and sugar content below the desired value for juice production. Koyama et al. (2015) indicate that the application of abscisic acid (*S*-ABA) to promote color of 'Isabel' grapes resulted in more intense color juice, showing greater acceptance of these juices by the tasters, when compared to the 'Isabel' juice from grapes non-treated with *S*-ABA (100%). Among the evaluated attributes, the juice color is one of the most important attribute, since juices with a more intense coloration usually have greater acceptance by the tasters (Pontes et al., 2010).

For the second evaluation period, the 'Bordô' juice 100% presented greater expressiveness in all attributes (Table 2, Figure 3). The blend 'Bordô' 75% + 'Niagara Rosada' 25% also presented a good overall acceptability by the tasters, similar to 'Bordô' 100% in the color and body attributes. The blend 'Bordô' 50% + 'Niagara Rosada' 50% resembled the 'Bordô' 75% + 'Niagara Rosada' 25% treatment in the body, flavor, aroma and overall acceptability attributes.

Table 2. Mean values and corresponding standard deviation of color (CL), aroma (AR), flavor (FV), body (BD) and overall acceptability (OA) in the sensory analysis of different grape juices, in the second evaluation period.

TREATMENTS	CL	AR	FV	BD	OA
Niagara Rosada 100%	3.5 ± 0.6	4.3 ± 0.3	3.7 ± 0.5	3.7 ± 0.5	3.3 ± 0.3
Isabel 100%	5.3 ± 0.5	4.0 ± 0.5	4.2 ± 0.4	5.2 ± 0.2	4.5 ± 0.4
Bordô 100%	6.3 ± 0.3	4.8 ± 0.5	5.2 ± 0.5	5.3 ± 0.2	5.0 ± 0.3
Isabel 90%+Bordô 10%	6.2 ± 0.4	5.0 ± 0.4	4.5 ± 0.3	5.2 ± 0.3	4.8 ± 0.4
Isabel 80%+Bordô 20%	6.3 ± 0.3	5.0 ± 0.4	5.3 ± 0.3	5.2 ± 0.3	5.4 ± 0.3

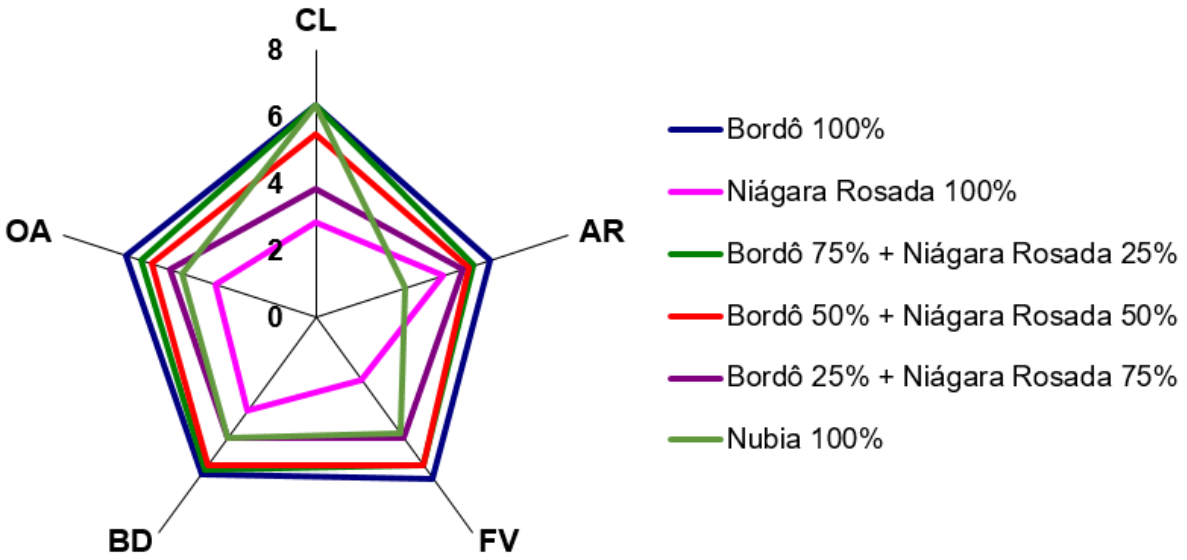

Figure 3. Sensory analysis of different grape juices concerning color (CL), aroma (AR), flavor (FV), body (BD) and overall acceptability (OA), in the second evaluation period.

Similar to the observed in the first evaluation period, the 'Niagara Rosada' juice 100% showed less acceptance by the tasters. However, blends with 'Bordô' up to the order of 50%, increased the acceptance of this juice, improving all attributes. Therefore, when a higher proportion of 'Niagara Rosada' juice was added to the blend, the acceptance of the beverage reduced, especially in the color attribute. During the juice production, the berry color influences decisively on the final product (Guerra 2003) and consequently, it is related to the attractiveness of the juice by consumers (Matsuura et al., 2002).

The 'BRS Nubia' juice 100% resembled the 'Bordô' 100% in the color attribute, and could be a potential juice for blends, in order to improve the color attribute, as the 'Bordô' cultivar. Rizzon and Meneguzzo (2007) reported the use of 'Bordô' cultivar in some blends, due to the increase of color intensity in juices and wines from poor coloration cultivars, since it presents high coloration and also has lower total acidity, according to Rizzon and Link (2006).

For the aroma attribute, the 'Nubia' juice 100% did not obtain good acceptance, presenting lower performance than 'Niagara Rosada' juice 100%. This may be due to the association that most tasters make between the 'Niagara Rosada' aroma and the aroma from 'fresh grapes' in general (Barnabé et al., 2007).

Regarding the soluble solids content in the first evaluation period, none of the juices had higher value than 14 °Brix (Table 3). However, in the second, the 'Bordô' juice 100% and the blend 'Bordô' 75% + 'Niagara Rosada' 25% presented values above 14 °Brix, considered as the minimum adequate content for grape juices (Pinheiro 2009). In the other blends, with the increase of the 'Niagara Rosada' juice quantity, a dilution in soluble solids content was observed. The 'Bordô' juice evaluated in the second period was commercial, consequently, it was expected to present soluble solids content above 14 º Brix.

On the other hand, because the other juices were obtained by the 'Welch' method, the addition of water to the juices during the extraction process by steam entrainment, probably diluted the soluble solids from these juices. According to Cristófoli et al. (2008a, 2008b) this technique involves the addition of 8 to 17% of water to the grape juice.

The taster's profile evaluation results, regarding age, occupation, level of education and fruit juice preference are presented in the Figure 4, separated by genders. The predominant age group among the tasters ranged from 25

to 35 years. Regarding occupation and level of education, 100% of the tasters had a college degree (undergraduate). Concerning preference, the tasters were able to choose more than one alternative. However, orange juice predominated as the most appreciated, followed by grape juice.

Table 3. Soluble solids content (ºBrix) from grape juices evaluated in the first evaluation period.

Treatments	SS (ºBrix)
'Bordô' 100%	13.3
'Niagara Rosada' 100%	10.0
'Isabel' 100%	13.1
'Isabel' 90% + 'Bordô' 10%	13.4
'Isabel' 80% + 'Bordô' 20%	13.3

Table 4. Soluble solids content (ºBrix) from grape juices evaluated in the second evaluation period.

Treatments	SS (ºBrix)
'Bordô' 100%	15.5
'Niagara Rosada' 100%	9.8
'Nubia'100%	12.4
'Bordô' 75% + 'Niagara Rosada' 25%	14.4
'Bordô' 50% + 'Niagara Rosada' 50%	12.7
'Bordô' 25% + 'Niagara Rosada' 75%	11.3

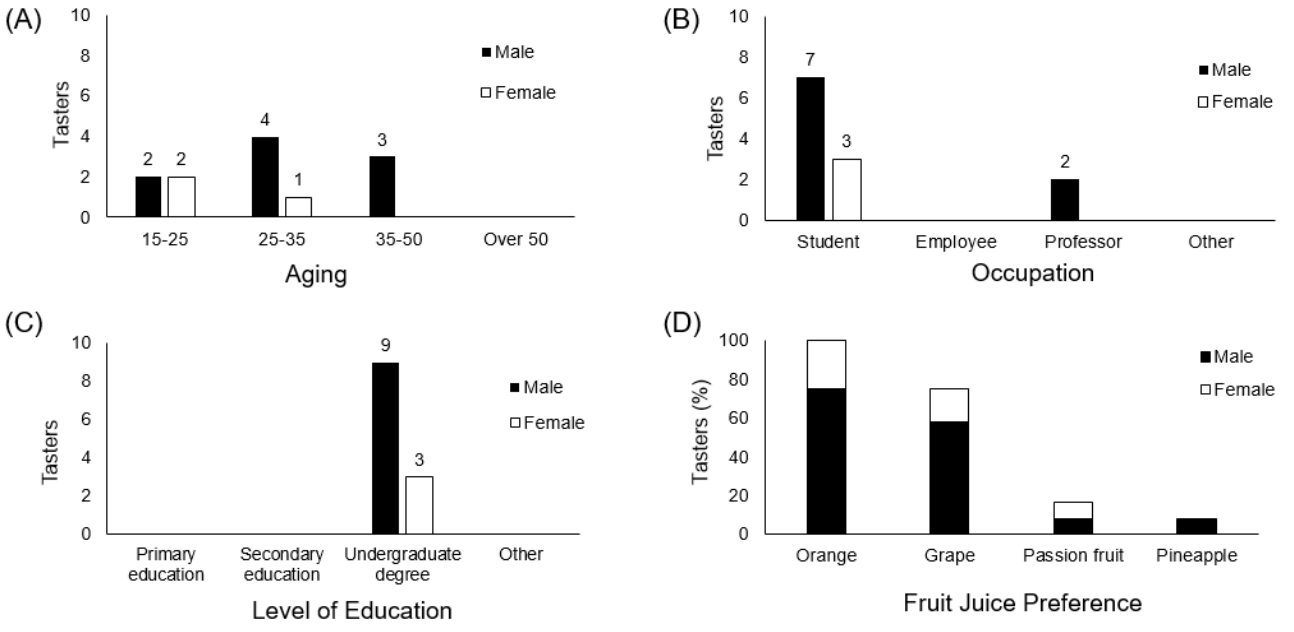

Figure 4. Taster's profile evaluation regarding aging (A), occupation (B), level of education (C), and fruit juice preference (D). Londrina, PR, Brazil.

CONCLUSIONS

In this exploratory analysis, the 'Niagara Rosada' juice 100% presents low acceptance, while the 'Bordô' and 'Niagara Rosada' juices up to 1:1 (v:v) have high acceptance. The 'Bordô' and 'Isabel' blends also have high acceptance, confirming the importance of 'Bordô' juice for grape juice blends. The 'Nubia' juice 100% may be an alternative for grape juice blends due to its intense color.

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