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Physical-chemical and sensory characterization of two important grape cultivars in Brazil

Caracterização físico-química e sensorial de duas importantes cultivares de uva no Brasil

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ABSTRACT

The grapevine (*Vitis* spp.) is the one main fruit grown in the world. One of the primary requirements of production destined to be consumpted *in natura* is the acceptance of product in the consumer market. Thus, the aim of this work was to evaluate the physico-chemical characteristics and the sensorial acceptance of grapes 'Niágara Rosada' and 'Niágara Branca'. The experimental design was in a one-factor scheme, with two levels. The evaluated variables were bunch length, berry diameter, soluble solids content, pH and titratable acidity. For the sensorial evaluation, the attributes color, aroma, sweetness, acidity, flavor and overall acceptance were evaluated using a hedonic scale of nine points, besides the intention to buy. The 'Niágara Branca' presented higher mean for cluster length and 'Niágara Rosada' for berry diameter. For soluble solids and titratable acidity, 'Niágara Rosada' presented higher mean. In the sensory analysis, the 'Niágara Rosada' obtained the highest note for color and the 'Niágara Branca' for sweetness; however, the two cultivars had good overall acceptance, with grades between 8.3 and 8.4. It is concluded that the 'Niágara Rosada' and the 'Niágara Branca' presented good acceptance by the evaluators.

Keywords: Niágara Rosada, Niágara Branca, acceptance test, grapevine, in natura consumption, *Vitis* spp..

RESUMO

A videira (*Vitis* spp.) é uma das principais frutas cultivadas no mundo. Um dos principais requisitos de produção destinados ao consumo *in natura* é a aceitação do produto no mercado consumidor. Assim, o objetivo deste trabalho foi avaliar as características físico-químicas e a aceitação sensorial das uvas 'Niágara Rosada' e 'Niágara Branca'. O delineamento experimental foi em esquema fatorial, com dois níveis. As variáveis avaliadas foram comprimento do cacho, diâmetro da baga, teor de sólidos solúveis, pH e acidez titulável. Para a avaliação sensorial, os atributos cor, aroma, doçura, acidez, sabor e aceitação geral foram c avaliados por meio de uma escala hedônica de nove pontos, além da intenção de compra. A 'Niágara Branca' apresentou maior média para o comprimento do cacho e 'Niágara Rosada' para o diâmetro das bagas. Para sólidos solúveis e acidez titulável, 'Niágara Rosada' apresentou média mais alta. Na análise sensorial, a 'Niágara Rosada' obteve a nota mais alta para cores e a 'Niágara Branca' para doçura; no entanto, as duas cultivares tiveram boa aceitação geral, com notas entre 8,3 e 8,4. Conclui-se que a 'Niágara Rosada' e a 'Niágara Branca' apresentaram boa aceitação pelos avaliadores.

Palavras-chave: Niágara Rosada, Niágara Branca, teste de aceitação, videira, consumo *in natura, Vitis* spp..

1 INTRODUCTION

The demand for a healthier and more balanced diet is increasing among a large part of the world's population (PENSO et al., 2018). In this sense, the interest of the benefits of fruit

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consumption for health is increasing (YAHIA et al., 2017). Thus, increasing consumer awareness about food and health has led to increased consumption of fresh fruits (RICARDO-RODRIGUES et al., 2017).

One of the most important fruits in the world is grapes, which can be used in the production of juice, wine or jelly as well as consumed in natura (ZHAO et al., 2017). According to Singh et al. (2015) daily consumption of whole grape products can be very useful for promoting better health.

According to Mello (2019) in 2018 an average of 3.61 kg of table grape per inhabitant per year was consumed in Brazil. In addition, in 2018, 773,955 tons of grape production were destined for consumption in natura, equivalent to almost 50% of the national production of this fruit (MELLO, 2019).

The 'Niágara Branca' (*Vitis labrusca* L. x *Vitis vinifera* L.) is native from the United States and has easy growing (POMMER et al., 2003). It was introduced in Brazil around 1894. It has medium vigor and medium resistance to fungal diseases. Their clusters have medium size, are compact, cylindrical-conical, resulting in a rounded or oval shape (MAIA, 2012). The 'Niágara Rosada' is the result of a somatic mutation that occurred in the 'Niágara Branca' grape in Louveira, then Jundiaí-SP district, Brazil, in 1933. It is very similar to the 'Niágara Branca' in plant vigor and size, shape of bunches and berries, and its pink color is highly appreciated by consumers (MAIA, 2012).

In 2016, 'Niágara Branca' was the fifth most non-wine cultivar in Brazil with 27.9 million pounds, and 'Niágara Rosada', the ninth, with 9.5 million pounds of grapes harvested (COPELLO, 2017). Although this placement, 'Niágara Rosada' has an excellent acceptance in the market, besides the lower cost of production and possibility of production in other times (MARTINS et al., 2014), being an alternative for small producers aiming their production to supply the local markets (SILVA et al., 2018). In the case of 'Niágara Branca', almost all the production is destined for processing, for elaboration of table wines and juices (Maia, 2012). Aiming the table market, there are few publications on the characterization of physical and chemical parameters of 'Niágara Rosada' and 'Niágara Branca' grapes.

In addition, in order to measure consumer acceptance in relation to in natura consumption, the nine-point structured hedonic scale can be used, which is probably the most used affective method, due to the reliability and validity of its results, besides the simplicity to be used by the tasters (VILLANUEVA et al., 2005).

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Based on these aspects, the present work had the objective of evaluating the physical-chemical characteristics and the acceptance of grapes 'Niágara Rosada' and 'Niágara Branca' by consumers through sensorial analysis.

2 MATERIALS AND METHODS

The experiment was carried out in the 2016/17 harvest in a commercial vineyard located in the municipality of Pelotas, Rio Grande do Sul (RS), Brazil, whose coordinates are 31° 29' 14.6 "S 52° 32' 59.7" W.

'Niágara Rosada' and 'Niágara Branca' grapes with five-year-old, grafted on the 'Paulsen 1103' rootstock were used, conducted in the trellis system, spaced at 2.5 between rows and 1.85 m between plants and irrigated by micro sprinklers. Pruning was performed on 25/08/2016, of the mixed type, leaving sticks and spurs.

The experimental design used was a randomized block design with two treatments, five replications and five plants per plot. The treatment factor tested was the variety of grapes, with 2 levels ('Niágara Rosada' and 'Niágara Branca').

The grapes were harvested with the aid of pruning shears, and the grape harvesting point was determined by the producer, coinciding 166 days after pruning. After the harvest, the clusters were transported in a thermal box to the Eliseu Maciel Agronomy College, belonging to the Federal University of Pelotas (UFPel), located in Capão do Leão, Brazil.

For the determination of the physical-chemical characteristics, 50 representative clusters per block (10 clusters per plant) were selected. For the physical characteristics the length of clusters (cm) was evaluated, using a graduated ruler, and the diameter of berries (mm), using a pachymeter.

The chemical characteristics evaluated were: soluble solids (SS), using the ATAGO® digital refractometer, with the result expressed in °Brix; pH, determined with benchtop pH meter QUIMIS®; and titratable acidity (TA) by the titration method using 10 mL of the sample diluted in 90 mL of distilled water and titration with 0.1N NaOH solution until pH 8.2 was reached and the results expressed as percentage of tartaric acid (INSTITUTO ADOLFO LUTZ, 1985).

The sensorial analysis of the grapes was carried out in individual booths, at the UFPel Sensory Analysis Laboratory, and counted on 50 untrained tasters. The experimental design was in randomized complete blocks, where each taster was considered a block.

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First, the profile of the judges was determined applying a questionnaire that evaluated the age, occupation, schooling, grape preference and frequency of in natura grapes consumption. Data were separated and presented according to sex (male and female).

The attributes color, aroma, sweetness, acidity, flavor and overall acceptance of the samples were evaluated using a hedonic scale of nine points, which ranged from "dislike extremely (1)" to ''like extremely (9)'' (VILLANUEVA et al., 2005).

Each evaluator received the fruits at room temperature were served in the quantity of 4 berries, in plastic cups of polyethylene. Each judge received in randomized order, the two coded samples with random three-digit numbers. For the cleaning of the mouth before and between the evaluations, the mineral water was served at room temperature ($\pm$ 24°C).

In addition to the samples, an entire cluster of each grape was available for visual analysis. The intention to purchase of each sample was also determined.

The data were submitted to analysis of variance through the F-test ($p \leq 0.05$). Statistically significant, the effects were compared by the t-test ($p \leq 0.05$).

3 RESULTS AND DISCUSSION

For the physical variables, the 'Niágara Branca' presented the highest average for the cluster length, 14.0 cm, differing significantly from the 'Niágara Rosada', with 13.7 cm. However, the opposite was observed in relation to the berry diameter, considering that the highest mean was recorded by the 'Niágara Rosada', with 19.5 mm, differing from the 'Niágara Branca', which presented 19.1 mm (Table 1). If the fate of these grapes is the table market, such variables may influence the acceptance of the consumer market, as it evaluates the criteria for the consumer to obtain fruits of peaches and nectarines, Penso et al. (2018) verified that the size of the fruit stood out among the main criteria in the acquisition by the consumer.

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TABLE 1. Physical characteristics of the clusters of 'Niágara Rosada' and 'Niágara Branca' grapes. Capão do Leão, Brazil, 2017.

Grape	Length of clusters (cm)	Diameter of berries (mm)
Niágara Rosada	13.7 b[1/]	19.5 a
Niágara Branca	14.0 a	19.1 b
CV (%)	4.0	5,0

[1/]Averages followed by different letters in the column differ by t-test (p≤0,05). CV (%): coefficient of variation.

Regarding the soluble solids content, the 'Niágara Rosada' grape presented higher content, 16.7° Brix, differing from 'Niágara Branca', with 15.7° Brix (Table 2). The soluble solids content verified here indicated that the samples were in compliance with the Brazilian commercial standards reported in Normative Instruction N° 1, dated February 1, 2002, which determines that the rustic grapes present at least 14° Brix (BRASIL, 2002).

TABLE 2. Chemical characteristics of the berries of 'Niágara Rosada' and 'Niágara Branca' grapes. Capão do Leão, Brazil, 2017.

Grape	SS [a/] (°Brix)	pH	TA [b/] (% titratable acidity)
Niágara Rosada	16.7 a[1/]	3.58 [NS]	0.65 a
Niágara Branca	15.7 b	3.54	0.47 b
CV (%)	3.6	6.3	13.2

[1/]Averages followed by different letters in the column differ by t-test (p≤0,05). [NS]: not significant by the F-test (p≤0.05) of the analysis of variance. CV (%): coefficient of variation. [a/]: soluble solids. [b/]: titratable acidity.

Regarding pH, there was no significant difference between cultivars, with values being 3.58 and 3.54 for 'Niágara Rosada' and 'Niágara Branca', respectively (Table 2).

As for titratable acidity (TA), there were statistical differences between the two cultivars, with 'Niágara Rosada' presenting 0.65 and 'Niágara Branca' 0.47% tartaric acid (Table II).

Soluble solids contents and titratable acidity are of paramount importance in the market, since they are indicators of fruit maturity, directly influencing their quality and, consequently, their flavor.

Sensorial analysis results of the grapes regarding color, aroma, sweetness, acidity, flavor and overall acceptance are described in Table 3.

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TABLE 3. Average of attributes color, aroma, sweetness, acidity, flavor and overall acceptance of 'Niágara Rosada' and 'Niágara Branca' grapes. Capão do Leão, Brazil, 2017.

Cultivar	Color	Aroma	Sweetness	Acidity	Flavor	Overall acceptance
Niágara Rosada	8.6 a[1/]	8.1 [NS]	8.1 b	7.2 [NS]	8.2 [NS]	8.4 [NS]
Niágara Branca	8.2 b	8.1	8.5 a	7.2	8.4	8.3
CV (%)	9.1	11.7	12.0	21.7	10.3	10.6

[1/]Averages followed by different letters in the column differ by t-test ($p \leq 0,05$). [NS]: not significant by the F-test ($p \leq 0.05$) of the analysis of variance. CV (%): coefficient of variation.

For the color, with the cultivar Niágara Rosada, the highest average score was obtained, 8.6, differing statistically from 'Niágara Branca', where the mean was 8.2 (Table 3). This result is in agreement with Maia (2012), who mention that the two cultivars have similar characteristics, but because it is rosy in color, the cultivar Niágara Rosada is more attractive to the consumer. Mascarenhas et al. (2010), in sensory evaluation with grapes 'Italy', 'Superior Seedless', 'Benitaka' and 'Isabel', obtained results similar to this experiment, since grapes with darker shades were preferred compared to grapes of lighter tones. Trevisan et al. (2006), analyzing the consumer preference for the quality characteristics of the peach, mentioned that consumers buy fruits considering color as the main attribute at the time of choice. According to Mascarenhas et al. (2013), the coloring of berries is one of the most attractive quality attributes for consumers, which according to Trevisan et al. (2006) is associated with maturation, freshness and flavor.

Regarding the aroma, there was no significant difference and the two cultivars presented, on average, the same note (Table 3). Penso et al. (2018) evaluating the criteria for the consumer to acquire fruits of peaches and nectarines, around 2% of the evaluators cited the aroma as the first degree of importance in the choice of product.

In the sweetness aspect, the cultivars tested differed from each other and the highest mean was recorded in 'Niágara Branca' (Table 3). However, if we relate this note to the total soluble solids, it is verified that the 'Niágara Rosada' presented higher content in comparison to 'Niágara Branca' (Table 2). Thus, it can be inferred that the difference in acidity in the berries of the two cultivars interfered with the note of the sweetness attribute, since the lower

acidity of 'Niágara Branca' (Table 2) may have favored the increase of the sweetness sensation in the evaluation of the judges.

In the acidity attribute, the two cultivars presented the same average scores (Table 3). Penso et al. (2018) reported that most consumers prefer fruits with low acidity and sweet taste in grapes. However, it is observed that the acidity difference mentioned in the chemical analysis (Table 2) did not influence the judgment of the evaluators. In the sensory evaluation of peaches, Trevisan et al. (2006) obtained a different result of this experiment, where the preference of the consumers was for fruits with lower acidity content.

As for flavor, the cultivars did not differ. The grades of the hedonic scale varied between 8.2 and 8.4, indicating good acceptance of the grapes (Table 3). Trevisan et al. (2006), in sensory analysis of peaches, described that after color, the flavor emerges as the main attribute when the consumer chooses the fruit, which is characterized as a synonym of quality.

In the overall acceptance of the samples there was no significant difference between the cultivars, with a good acceptance of the judges, with a mean score of 8.4 for 'Niágara Rosada' and 8.3 for 'Niágara Branca' (Table 3). This is an important indicator in the commercialization of these grapes and Figure 1A reiterates this result, considering that the majority of the judges of both sexes would buy the two cultivars. On the other hand, comparing only when the judges opted for a cultivar, the highest number of male judges showed a preference for 'Niágara Rosada' and female judges for 'Niágara Branca' (Figure 1A).

Regarding the profile of the judges, it is verified that the predominant age of the judges varied between 15 and 25 years (Figure 1B). As for sex, the predominance was for female and female raters for the 15-25 and 26-35 groups, and for the male group of 36-50 years. The occupation data are shown in Figure 1C. In both sexes the students represented the majority of the judges. For teachers, there are only female judges, and for another occupation, only male evaluators were present in the analysis. Regarding schooling, males were higher in the number of judges for high school, and females for higher and postgraduate levels (Figure 1D). For males, the second level of education was predominantly postgraduate, while in female examiners, the first was postgraduate and the second level of education with the highest number was higher education.

When questioned about the preference for type of fruit for in natura consumption, grape and bergamot (*Citrus bergamia*) are preferred by male judges, whereas for females are grape and orange (*Citrus sinensis*) (Figure 1E). For the judges who pointed out the grape among the most consumed fruits, they wondered what varieties they preferred. For both sexes, the same

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behavior is observed, where 'Niágara Rosada' was the most cited, and secondly, 'Italy' (Figure 1F). For the male, the 'Niágara Branca' is the third placed, while for the female the third most cited was the 'Rubi', with the 'Niágara Branca' coming in fourth place. As for the frequency of consumption of fresh grapes, most evaluators of both sexes occasionally consume grape (minimum once a year) (Figure 1G). Consumption behavior was similar between the sexes, where secondly moderate consumption (minimum once a month), followed by frequent (minimum once a week), and lastly there are those who never consume, and no man has selected this option.
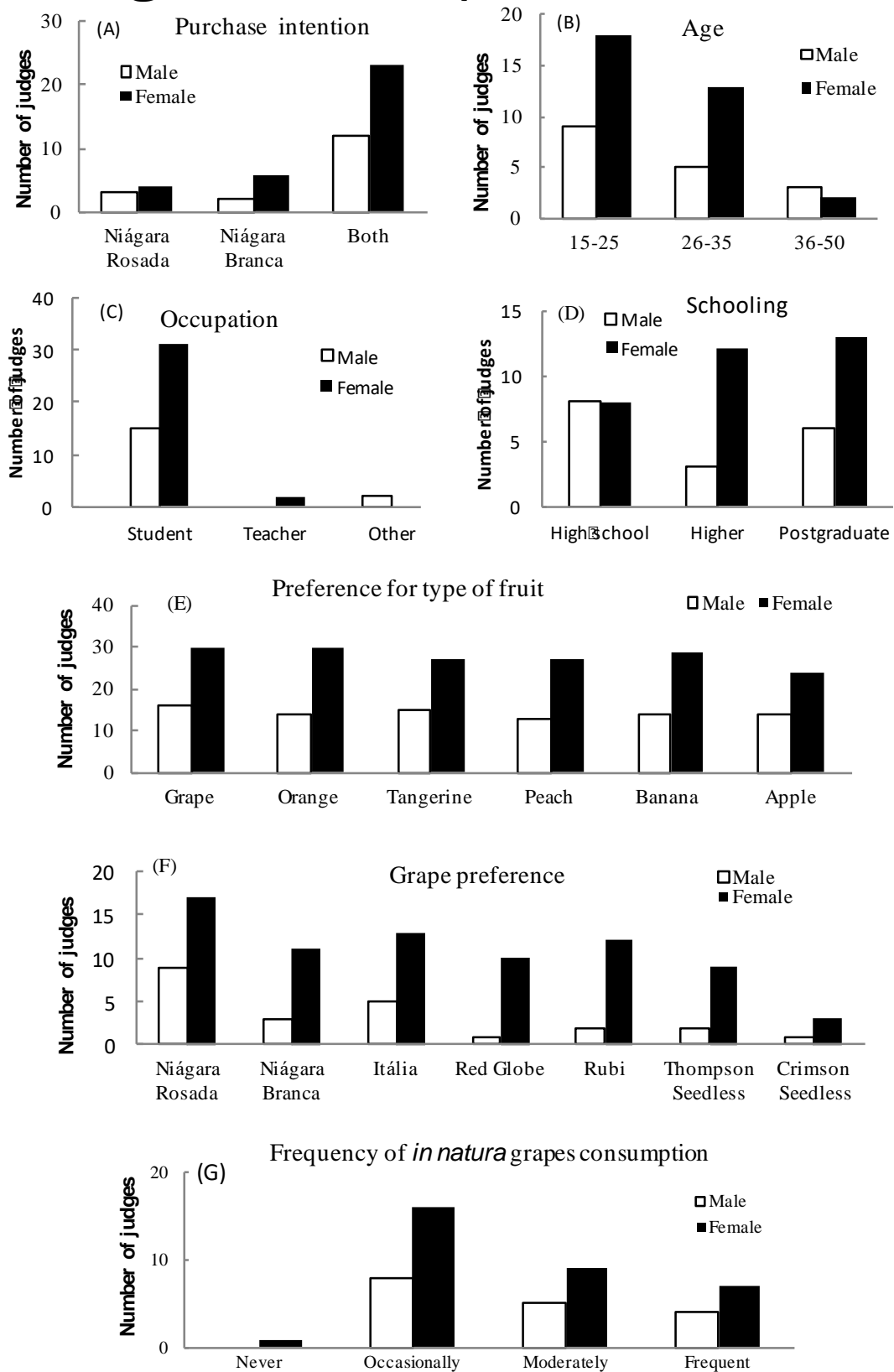
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Figure 1. Results of purchase intention (A); age (B); occupation (C); schooling (D); preference for type of fruit (E); grape preference (F); frequency of in natura grapes consumption (G). Occasionally: minimum once a year. Moderately: minimum once a month. Frequent: minimum once a week. Capão do Leão, Brazil, 2017.

According to Mascarenhas et al. (2010), consumer acceptance is a crucial part of the consolidation process of a product on the market. Mota et al. (2009) cite that because it is a fruit consumed in natura, factors such as the balance between sugars and acidity and the coloring of the berry are quality differentials for the 'Niágara Rosada'. However, in this study, it can be observed that in spite of the higher color of the berries obtained by 'Niágara Rosada' in relation to 'Niágara Branca', in the two cultivars the average for this attribute was higher than 8.0, second highest grade in the hedonic scale. In addition, there was no significant difference as to the acceptability of the judges for most attributes, indicating the potential of both in the table grapes market.

4 CONCLUSION

The 'Niágara Rosada' and 'Niágara Branca' grapes have physical-chemical characteristics compatible for in natura consumption.

For the sensorial attributes, both cultivars presented satisfactory acceptance.

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