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Physical, Chemical-physical and chemical characterization of must and integral juice in grape cultivars

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Abstract: In recent years there has been an important increase in the production of grape derivatives such as integral grape juice. Thus, it was intended with the accomplishment of this study to evaluate the composition of the grape juice of the grape cultivars: Bordô, Concord e Isabel in the composition of integral grape juice from the Bento Gonçalves-RS. The samples were evaluated for classical analysis:°Brix, pH, titratable acidity, ratio Brix / titratable acidity made through methods, physics, physical chemistry and chemistry. The mineral elements sodium and potassium analyzed by flame emission and color intensity by colorimetry. For the statistical analysis of the data, the Tukey test was applied at the 5% level of significance. The contents of integral grape juice evaluated, SS, A Tand minerals presented according to the legislation, the pH was within the comparative average with other works. The determination of the color demonstrated the need to make cuts.
Keywords: Quality, grape must, Vitis labrusca

Introduction

The brazilian viticulture is a traditional activity of temperate regions and news poles of grape production in the northern regions of Paraná, northwest of São Paulo, and soon afterwards in the northern region of Minas Gerais, demonstrating strong potential, as an alternative to tropical regions (Leão & Possídeo, 2000) (Protas et al., 2006).In Brazil, grape juice is mainly made with American and/or hybrid grapes, Bordô, Concord and Isabel (all species*Vitis labrusca*). However, in recent years has also been used the cultivar Niagara White for the elaboration of white grape juice. Besides these cultivars, there are others also used, such as, BRS Rúbea, BRS Cora and BRS Violet, launched by Embrapa Grape and Wine, as well as clones Isabel Precocious and Concord Clone 30 for the elaboration of red grape juice (Rizzon & Meneguzzo, 2007).

Bordô grape cultivar, is originally from Ohio, U.S.A.The correct name of the cultivar is Ivês, but according to the region where it is cultivated it receives a specific name. In Paraná, "Terci", in Minas Gerais, "Folha de Figo" and in Rio Grande do Sul is known as "Bordô". This grapevine cultivar has great commercial importance only in regions with defined winter, presenting great difficulty of development in tropical climates. It is a rustic cultivar, which presents good resistance to fungal diseases and good productivity (Rizzon & Meneguzzo, 2007), being indicated for agroecological crops (Giovannini, 2008). The grape has high concentration of coloring matter, main motive of its significant diffusion in the market (Rizzon & Meneguzzo, 2007; Camargo e Maia, 2005). This cultivar is very used in cuts, as it allows to increase the color intensity of juices and wines from cultivars with poor coloration (Giovannini, 2008; Rizzon & Meneguzzo, 2007).

The Concord is relatively precocious, moderately vigorous and quite productive when well managed, being a reference for juice quality due to its aroma and flavor characteristics. It is a cultivar of high rusticity, very cultivated in the States of the

South, where it is normally planted in free-standing and, often, dispensing with treatments with fungicides (Camargo & Maia, 2005). This cultivar is from Massachusetts, USA. It is also known as "French", "Bergerac" and "French Black", being very widespread in the United States, especially in New York (Rizzon & Meneguzzo, 2007).

The cultivar Isabel, is native to South Carolina, USA, being the most widespread cultivar in the vineyards of Brazil. It is known by the name of "Isabella" (internationally), "Frutilla", "Brasilera" and "Brasileña" (Uruguay) and "Uva Fragola"(Giovannini, 2008). It is a versatile cultivar used for all types of oenological product, *in natura* consumption, for the elaboration of wines, juice, vinegar and also for the manufacture of sweets and jellies(Giovannini, 2008; Camargo & Maia, 2005).Normally, the products made with grapes of the Isabel cultivar need to be cut with wine or juice of dyers cultivars to obtain products with the color intensity that the market demands (Camargo & Maia, 2005).These cultivars have the advantage of maintaining their flavor even when exposed to heat during the processing steps and these products are not of long maturation, offer affordable prices and serve the palate of consumers in each region (Marzarotto, 2005) (Guerra et al., 2009).

The decree No. 6871 of June 4, 2009, sumo or juice is the non-fermented, non-concentrated beverage, excepted in the cases specified, and undiluted, intended for consumption, obtained from ripe fruit and sound, or part of the plant of origin, by appropriate technological processing, subjected to treatment that ensures its conservation until the moment of consumption(MAPA, 2009). According to Administrative Rule No. 55, of July 27, 2004, grape juice can be designated integral or simple (without addition of sugars and in their natural concentration), concentrated (it is the juice partially dehydrated, by means of a suitable technological process, presenting minimum concentration equivalent to 65 ºBrix in natural fruit solids), dehydrated(it is the solid product obtained by the dehydration of grape juice with a moisture content of not more than 3%), reprocessed or reconstituted(is the product obtained by diluting the concentrate and/or dehydrated to its natural concentration).The legislation further states that grape juice, when added to sugars, bears the designation "sweetened juice"(MAPA, 2004).

According (Maia et al., 2013) the fruit juices such as whole grape juices are being incorporated into the market in great quantity in the reduction of price and practicality of consumption, in which it constitutes an economically important market niche in the national viticulture(BARBOSA, 2010). Therefore, the investment in technological and innovative resources, focused on improving the quality of the product, is essential to promote the competitiveness and sustainability of this Brazilian Wine sector (Barbosa, 2010).

The production and marketing of grape juice have grown considerably in recent years. According to IBRAVIN data, the commercialization of ready-to-drink juices grew 20.3% in 2010 compared to the previous year, 2009. Another important fact is the growth in the commercialization of whole / natural grape juice, which shows a greater preference for natural products.

As regards the chemical composition, grape juice has a high content of glucose, fructose and lower amounts of arabinose, galactose, mannose, rhamnose, ribose, sucrose, and xylose, thus considered as an energy food (Ough, 1996; Rizzon et al., 1998). This composition depends on the cultivars destined to the elaboration of juices must present some characteristics, such as good yield in must, adequate sugar / acidity ratio, pleasant and well defined aroma and taste, as well as good maturation and sanity(RIZZON & Meneguzzo, 2007).The more mature grapes favor a juice of better quality, therefore, to present higher sugar content, expressed as total soluble solids, and have a lower acidity, expressed as tartaric acid, having a balanced sugar/acidity ratio(Marzarotto, 2005).

The implementation of standards in grape processing favor a quality product, In the final product, these essential hygiene requirements and good manufacturing practice (GMP) in the manufacture of grape derivatives, Such as vinegars, jellies, sweets, wine and grape juices, which in addition to ensuring safety, add quality to products and consumers, reducing costs, product quality and increasing business profitability (BRASIL, 2000).

Thus, the objective was to characterize the physical, physico-chemical and chemical composition of whole grape juice of different brands in the region of Bento Gonçalves of grape cultivars *Vitis labrusca* Bordô (Ives), Concord and Isabel. Also, in general, to evaluate the influence of the chromatic intensity of the whole grape juice produced from these cultivars of American grapes.

Methods

We evaluated three cultivars musts *Vitisla brusca* (Bordô, Concord and Isabel) provided by Embrapa Grape and Wineand three different brands of integral grape juice obtained in supermarkets in the city of Bento Gonçalves-RS. The marks were coded as brand A (cultivars Bordô, Concord and Isabel), brand B (cultivars Concord and Isabel) and

brand C (cultivars Bordô and Isabel)for the accomplishment of the parameters: physical, physico-chemical and chemical. The chemical determinations consisted of: soluble solids (ºBrix), titratable acidity, pH, soluble solids ratio by titratable acidity. Minerals and color index analyzed according to the identity and quality standards established for the samples (BRASIL, 2000). The pH was determined by potentiometry, according as to the AOAC technique and the soluble solids were determined in the samples by reading in refractometer and expressed in ºBrix (AOAC, 2000).

The titratable acidity (AT) was determined by titration with 0.1N NaOH solution, expressed as g tartaric acid/g.100mL^{-1} juice, and the determination of the ratio of the soluble solids content by the titratable acidity was according to the methodology of the Adolfo Lutz Institute (2008).The color determination was used by the CIELAB system using portable brand colorimeter Konica Minolta CR/400-Sensing, INC-Japan (KONICA MINOLTA, 1998).The minerals that constitute the ashes, being K and Na were analyzed by emission of flame (PERKIN-ELMER, 2000).

At the time of analysis, bottles of must and grape juice of 0.5L were opened and homogenized separately for aliquot withdrawals. All analyzes were performed in triplicate for greater reliability of the results.

Statistical analyzes for the results were performed using the bilateral equality test for means ($p < 0.05$), through the Software IBM®SPSS® Statistics and with the assistance of the Software SISVAR 4.0 (FERREIRA, 2000), applying the Tukey test as mean test with a level of 5% of significance.

Results and discussion

The average values found for the physical, physicochemical and chemical analyzes of musts and juices are presented in Table 1.The mean values of soluble solids (SS) varied significantly among the samples analyzed. The juice of grape brand A presented higher value of soluble solids(16.30ºBrix), this difference occurs because this brand presents the three cultivars in its elaboration. The values of total soluble solids found in the grape juice analyzed are in the standards required by the Brazilian Legislation (Brasil, 1994), where the minimum required content is 14 ºBrix. Santana et al., (2008) detect variations of 14.21 to 17.30 ºBrix in commercial grape juices in Rio Grande do Sul .In the pH evaluation, small changes were observed in the mean values for the three brands of grape juice. The C mark presented the highest value than marks A and B. Rizzon & Miele (1995)found values for pH from 2.8 to 3.43, values similar to those found in the juices of marks A (3.26) and B (3.23).The pH is related to the taste quality of the juice and can be influenced by the genetic variability of the different cultivars used and by the processing(PEYNAUD, 1997).

Table 1- Comparison of the mean values for the respective analyzes

Parameters	Concord	Bordô	Isabel	Mark A	Mark B	Mark C
	Mean	Mean	Mean	Mean	Mean	Mean
°Brix (SS)	14.90a	15.37b	19.17c	16.30d	16.10d	14.80a
pH	3.06a	3.19a,b	3.10a	3.26a,b	3.23a,b	3.33b
AT(gtartaric acid/100mL^{-1})	0.85a	0.91b	0.83a	0.78c	0.76c	0.83a
SS/AT (tartaric acid)	17.55a,d	16.81a	23.06b	20.99c	21.29c	17.85d
K (mg/L)	59.95a,c	74.29a	63.86a,c	33.89b,d	22.16b	49.52c,d
Na (mg/L)	2.07a	1.55a	1.80a	2.27a	2.80a	1.77a

Note: The mean values in the same row and subtable that do not share the same subscript are quite different at $p < 0.0$ in the bilateral equality test for column means.The cells with no subscripts are not included in the test. The tests consider equal variances.

The titratable acidity (AT) of the whole grape juice analyzed ranged from 0.76 to 0.91 grams of tartaric acid/g.100 mL^{-1} of juice, with a maximum titratable acidity of 0.90 grams of acid Tartaric acid / g.100 mL $^{-1}$ juice (Ministry of Agriculture, 2004). The acidity of grape juice varies according to the characteristics of grape varieties used in processing (Rizzon & Link, 2006) (GURAK et al., 2008).

The ratio ºBrix / total acidity the balance between the sweet and sour taste of grape juice, therefore an indication of quality of grape juice (Pezzi & Fenocchio, 1976). The Brazilian Law establishes the limits of this ratio of 15 and 45(Brasil, 2000). The highest mean values represent less acidic grape juice. The ratio ºBrix / total acidity for the C mark (17.85) coincides with the values analyzed by Martins et al., (2009).

Mean sodium and potassium levels in the brands ranged from 22.16 to 49.52 mg/L and 1.77 to 2.80 mg/L respectively. One of the major functions of sodium in the human body, along with potassium and chloride, is to maintain an adequate fluid balance. Brazilian sanitary standards require that the mass of sodium be informed on the labels of foodstuffs(in mg) Per portion consumed, and can be informed with "zero mg sodium" or "does not contain sodium" when less than 5 mg(ANVISA, 2003). In one study, grape juice was used as mean potassium and sodium contents of 6.34 and 1.4 mg / L, respectively (Rizzon & Miele, 1995). In the same study it was found that the analytical results of most of the samples were higher than those reported on the packages.

Table 2. Results of the color parameters for the six samples analyzed

Sample	L*	a*	b*	C*	IC	h*
Bordô	18.58 c	2.12 d	1.17675 c	2.425 d	14.3995 e	361.6132 d
Concord	20.94325 a	6.06325 a	0.84 e	6.1215 a	23.7305 a	367.1932 a
Isabel	20.03675 b	3.84675 b	1.42325 b	4.1015 b	20.56 b	362.5785 c
Mark A	18.57675 c	2.40325 c	1.41 b	2.7865 c	16.814 d	361.5048 d
Mark B	18.56675 c	1.86 e	1.59 a	2.44775 d	15.8102 d	360.8698 e
Mark C	19.84675 b	3.91675 b	1.05 d	4.05525 b	18.9985 c	363.6425 b

Means followed by letters equal in the same column did not differ significantly by the Tukey test at the 5% level of significance (p <0.05),N experimental = 6. L * = 0 is black and L * = 100 total clarity; + A * = red and -a * = green; + B * = yellow and -b * = blue; C * = (a * 2 + b * 2) 1/2 purity of the color; Angle (Hue) h * = tg-1 (b * / a *) color tint; IC = color intensity.

The C mark presented the highest average content for the parameter L* (luminosity or clarity) in relation to mark A (18.57675) and mark B (18.56675), also showed higher value of C * or purity (4,05525) andh* or chromatic tonality(363,6425) in relation to the other samples of integral grape juice. The mark C presents in its composition the cv. Bordô, which is much used for cutting (Blends) in juices to increase the intensity of color and flavor in the juices elaborated by this grape cultivar. On the other hand, the B mark presented a lower value of C * (2,44775) and lower value of h * (360,8698) with respect to the A mark of C * (2.7865) and h * (361.5048), Respectively, this lower value found may be related to the yellow color, indicating a possible increase in the concentration of tannins, polymerization of tannins and combination of anthocyanins with tannins (Freitas, 2006). However, high values of b * aren't desirable in grape juice, as they may indicate increased oxidation of the product (Borges et al., 2013).

Conclusion

The parameters analyzed for soluble solids, titratable acidity and soluble solids ratio by titratable acidity, both for grape musts and for commercial grape juice brands are within the standards established by Brazilian Legislation. The pH analysis performed was close to the data reported in the literature. The contents presented in the labels of the analyzed brands differ significantly from the analytical results and the physical analysis of the color is an important attribute in the quality standard of the integral grape juice, being determinant the inspection and the commercialization of the products in the shelves in the supermarkets.

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