ADAPTATION OF "NIAGARA ROSADA" GRAPE MUST TO WINEMAKING BY PARTIAL CLUSTER DEHYDRATION

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ABSTRACT: This study aimed to verify the influence of partial dehydration of "Niagara Rosada" grape clusters in physicochemical quality of the pre- fermentation must. In Brazil, during the winemaking process it is common to need to adjust the grape must when the physicochemical characteristics of the raw material are insufficient to produce wines in accordance with the Brazilian legislation for classification of beverages, which establishes the minimum alcohol content of 8.6 % for the beverage to be considered wine. Therefore, given that the reduction in the water content of grape berries allows the concentration of chemical compounds present in its composition, especially the concentration of total soluble solids, we proceeded with the treatments that were formed by the combination of two temperatures (T_1-37.1^{o}C and T_2-22.9 ^{o}C) two air speeds (S_1: 1.79 m s^{-1} and S_2: 3.21 m s^{-1}) and a control (T_0) that has not gone through the dehydration treatment. Analysis of pH, Total Titratable Acidity (TTA) were performed in mEq L^{-1}, Total Soluble Solids (TSS) in ^{o}Brix, water content on a dry basis and Concentration of Phenolic Compounds (CPC) in mg of gallic acid per 100g of must. The average comparison test identified statistically significant modifications for the adaptation of must for winemaking purposes, having the treatment with 22.9 °C and air speed of 1.79 m s^{-1} shown the largest increase in the concentration of total soluble solids, followed by the second best result for concentration of phenolic compounds.

KEYWORDS: Chemical Composition, Must, Drying.

ADEQUAÇÃO DO MOSTO DE UVAS NIAGARA ROSADA PARA VINIFICAÇÃO ATRAVÉS DE DESIDRATAÇÃO PARCIAL DOS CACHOS

RESUMO: Este estudo teve como objetivo verificar a influência da desidratação parcial de cachos de uva Niagara Rosada na qualidade físico-química do mosto pré-fermentativo. No Brasil, durante o processo de vinificação, é comum a necessidade de adequação do mosto de uvas quando as características físico-químicas da matéria-prima são insuficientes para a obtenção de vinhos em conformidade com a legislação brasileira para classificação de bebidas, a qual estabelece o teor alcoólico mínimo de 8,6% para que a bebida seja considerada vinho. Portanto, tendo em vista que a redução do teor de água das bagas da uva possibilita a concentração de compostos químicos presentes em sua composição, principalmente a concentração de sólidos solúveis totais, procedeu-se aos tratamentos que foram constituídos pela combinação de duas temperaturas (T_1- 37,1 ^{o}C e T_2 - 22,9 ^{o}C), duas velocidades de ar (V_1- 1,79 m s^{-1} e V_2-3,21 m s^{-1}) e uma testemunha (T_0), que não passou pelo tratamento de desidratação. Foram realizadas análises de pH, Acidez Total Titulável (ATT) em mEq L^{-1}, Sólidos Solúveis Totais (SST) em ^{o}Brix, teor de água em base seca e Concentração de Compostos Fenólicos (CCF) em mg de ácido gálico por 100 g de mosto. O teste de comparação de médias identificou modificações estatisticamente significativas para a adequação do mosto no intuito de vinificação, tendo o tratamento com 22,9 ^{o}C e velocidade de ar de 1,79 m s^{-1} apresentado o maior incremento na concentração de sólidos solúveis totais, seguido do segundo melhor resultado para a concentração de compostos fenólicos.

PALAVRAS-CHAVE: composição química, mosto, secagem.

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INTRODUCTION

In Brazil, industrially processed grapes for wine production are generally not subjected to any form of convective or heat treatment that allows for improvements in the quality of the wine produced. The difficulty in determining the optimal harvest point plus the feature of the farming bring about a low concentration of soluble solids in the must. As the concentration of sugars in the must is fundamental so that during vinification the must produces significant amounts of alcohol (BARNABÉ & FILHO, 2008), the low concentration of sugars hinders or even prevents the achievement of table wines with alcohol contents as required by the Brazilian law, which is from 8.6 to 14%, according to a note published in the Official Union Gazette (DOU, 2004).

Adding sugar to the must looking to improve the alcohol content is common in many wineries. However, this process results in less full-bodied wines, with formation of crystals, besides increasing production costs. MENCARELLI et al. (2009), when studying the partial dehydration of grapes, found that the technique, both in low and in high temperature, allows for an increase in the concentration of sugar and other chemical compounds in the berry. The results obtained by BELLINCONTRO et al. (2004) and CONSTANTINI et al. (2006) ensure that this procedure can enable cost reduction with the addition of sugar in the must. However, partial dehydration of grapes is still a procedure rarely used in Brazil, being commonly seen in traditionally wine producing countries (CURVELO-GARCIA, 2005). However, the methodology practiced in these countries does not have any technique or tool that allows the control of environmental conditions and ensures the asepsis of the product.

The International Code of Oenologist Practices (CIPE, 2006) states that grapes for winemaking, when subjected to drying processes, lose the maximum of 20% of their initial water content and that the potential alcoholic content does not exceed 2% of the volume. Dehydration above 20% can cause physiological damage to the product, compromising its use in the production of must.

Surveys with fruit for industrial manufacturing and processing of juice, pulp and concentrates show that after reduction of the water content of the product, these can achieve greater amount of soluble solids, higher concentration of chemical components and increased microbiological stability (AZEVEDO & JARDINE, 2006). Studies assessing postharvest grape dehydration and its effect on sugar concentration, phenolic compounds and aromatic compounds in must and wines produced are reported by BELLINCONTRO et al. (2004), COSTANTINI et al. (2006), BROWN et al. (2008), BARBANTI et al. (2008) and SERRATOSA et al. (2010).

Therefore, the aim of this work was to verify the influence of partial dehydration of "Niagara Rosada" grape berries in the physicochemical quality of the must.

MATERIALS AND METHODS

Raw material

"Niagara Rosada" American grapes, harvest from July to November 2011, were collected in the city of Jales, northwest region of São Paulo, packed in cardboard boxes with capacity for up to 7kg and transported to the Laboratory of Thermodynamics and Power of the Agricultural Engineering College, State University of Campinas (LTE - UNICAMP).

After conducting a pre-cleaning of the grape clusters to remove the stems and berries damaged or compromised by the presence of fungi, a distribution of plots according to treatment and sampling for drying and physicochemical characterization trials were performed in the Laboratory of Postharvest Technology.

Partial dehydration of grapes

The partial dehydration of the clusters was performed inside a refrigeration room adapted for drying fruits and instrumented with sensors for temperature, relative humidity and mass loss in real time, as described in SILVA & TERUEL (2011). 25 clusters were used per treatment, arranged lengthwise in a hollow plastic casing, with the air flow passage occurring perpendicularly to the case.

Experimental design

The experimental design used was the completely randomized factorial 2 x 2, totaling four experiments and five treatments including the control. The treatments were a combination of two temperatures (T_1: 37.1 ^oC and T_2 : 22.9 ^oC) two air speeds ($S_{1:}$ 1.79 m s^{-1} and S_2: 3.21 m s^{-1}) and a control (T_0) which did not go through drying.

Physicochemical analysis

For the physicochemical analysis, six berries were removed randomly from each cluster, comprising the base area, middle and apex of the cluster, according to the procedure proposed by ARAÚJO et al. (2009). Then, the selected berries were ground and the must was separated for analysis. The physicochemical characterization of the musts was based on specific methodologies from ADOLFO LUTZ INSTITUTE (2005) from the following analysis: pH, Total Titratable Acidity (TTA) in mEq L^{-1} and Total Soluble Solids (TSS) in °Brix. The water content on a dry basis was obtained by drying in a forced air oven at 60°C until constant weight was achieved. Concentration of phenolic compounds (CPC) was quantified in mg of gallic acid per 100g of must, according to the methodology described by Vargas et al. (2008). The results obtained were subjected to analysis of variance, and the means were compared by the Tukey test at 95% reliance on the Sisvar 5.3 statistical software.

RESULTS AND DISCUSSION

From Table 1, the influence of partial dehydration treatments on the physicochemical characteristics of musts obtained from “Niagara Rosada” grapes can be observed. For all the parameters assessed the coefficient of variation of the responses reveals low dispersion of the data and homogeneity of the samples.

TABLE 1. Effect of partial berry dehydration in the physicochemical characteristics of the Niagara grape must.

Variable	Treatments					Mean	CV (%)	Prob>F.
	T_1S_1	$T_1 S_2$	$T_2 S_2$	$T_2 S_1$	T_0			
TSS (^{o}Brix)	17.53 d	18.43 c	21.40 a	20.07 b	16.76 e	19.16	0.58	0.0000
CPC (mg g^{-1})	1064.67 bc	1359.33 a	1221.33 ab	986.67 c	974.00 c	1141.9	4.39	0.0001
$U_{bs.}$	3.50 ab	3.32 ab	3.15 b	3.04 b	3.86 a	3.30	5.83	0.0281
TTA (mEq L^{-1})	108.11 a	107.50 a	83.98 c	82.52 c	101.85 b	96.01	1.39	0.0000
pH	3.24 abc	3.59 a	3.51 ab	2.86 c	3.01 bc	3.28	5.26	0.0052

Means followed by different letters in the line differ by the Tukey test at 5 % probability of error.

In evaluating the pH, significant changes were observed in mean values for the five treatments. Treatment "T1S2" presented a higher value than the others. Despite the pH value having varied from 2.86 to 3.59, it remained in a range considered as favorable to storage, according to RIZZON et al. (1998) it is interesting that the pH value be low, as this feature makes the must protected from the action of oxidative enzymes during pre-fermentation.

To DAUDT & FOGAÇA (2008), the pH value of the grape must is directly related to the amount of potassium present in the must. FOGAÇA et al. (2007), after analyzing the correlation between potassium content and pH of the must of wine grapes, suggest that the absorption of potassium and pH changes are mainly related to high temperature values of the ripening period of grapes. This behavior would justify the pH shown by treatment "T_1S_1", which was 3.59. However, according to RIZZON & SGANZERLA (2007), the change in grape pH is more related to the dilution of tartaric and malic acids.

According to LULU et al. (2005) and YAMAMOTO et al (2011), the results for soluble solids did not indicate the occurrence of incomplete ripening of bunches, ie, TSS level lower than 14 °Brix. The average value of total soluble solids reveals a great fermentation potential for the American "Niagara Rosada" must, because according to the results listed in scientific literature (MANFROI et al 2006; RIZZON & MIELE, 2004; CHAVARRIA et al 2008), this TSS value equates to the value of TSS for the must of some varieties of European grapes (*Vitis vinifera*).

BELLINCONTRO et al. (2004) were able to get an increase of up to 34% in the amount of total soluble solids of the produced must from partially dried grapes. By varying the temperature between 10 and 25 °C, BARBANTI et al. (2008) observed similar increase to the value of total soluble solids in the must.

The average values of Total Soluble Solids (TSS) varied significantly among the five treatments. Treatment "T_2S_2" showed the highest total soluble solids value (21.40°Brix). This difference compared to other treatments is possibly associated with the water content of the clusters, since according to SERRATOSA et al. (2010), the reduction of the water content of grape clusters results in musts with higher total soluble solids. Similarly, DIONELLO et al. (2009) assert that after dehydration, the amount of total soluble solids and chemical components becomes high in fruits. These statements support the hypothesis of partial dehydration adopted in this study, because both treatments with the highest total soluble solids ($T_2S_{2\,e}$ T_2S_1) presented the lowest water content on a dry basis of the bunch (3.15 and 3.04, respectively).

The TSS value of the control was similar to that observed in literature for the same culture, while the concentration of phenolic compounds presents great differences regarding the outcome of researches which evaluate this parameter (TECCHIO et al 2009; SCHIEDECK et al 1999; SOARES et al 2008; VEDANA et al 2008). It is believed that this variation results from the use of different methods for the extraction of phenolic compounds.

Ranging from 974.00 to 1359.33 mg g^{-1}, the concentration of phenolic compounds showed the highest values for treatments with higher air speed (T_1S_2 e T_2S_2). VEDANA et al. (2008) studied the effect of processing on the antioxidant activity of grapes and associate the increase in the concentration of phenolic compounds such as anthocyanins and flavonoids in the berry to the effect of disruption or breakage of the peel pectin molecules caused by high temperatures. This breakage allows the phenolic compounds present therein to be released into the must. According to FALCÃO et al. (2007), the temperature of 45 ^{o}C is limiting for the stability of grape peel anthocyanins.

The total acidity was higher in treatments "T_1S_1" e "T_1S_2" (108,11 e 107,50 mEq L^{-1}, respectively). However, the values variation range is similar to that observed in studies in which the grape must was characterized (RIZZON & MIELE, 2002; Mota et al 2010; FOGACA et al 2007).

RIZZON & MIELE (2002) assert that the variation in the amount of titratable acidity for the grapes *Vitis labrusca* cultures is due to the composition of the fruit in relation to organic acids and berry size, which determines different ratio between skin and pulp. In some cases, the increase in volatile acidity is related to the sanitary quality of the grapes and the equipment used during the preparation of the must (JUBILEE et al. 2010).

The joint analysis of the water content on a dry basis, along with the changes in the physicochemical characteristics of the wine, allow for the identification of the influence of dehydration levels achieved with the increase of the positive aspects to the must.

From the analysis of Figure 1, where the gains obtained from the main feature in terms of must adaptation (soluble solids concentration) and from another important feature in terms of differentiation of must (phenolic compounds concentration) are shown, the existing potential for applications of partial dehydration of the bunches can be observed.

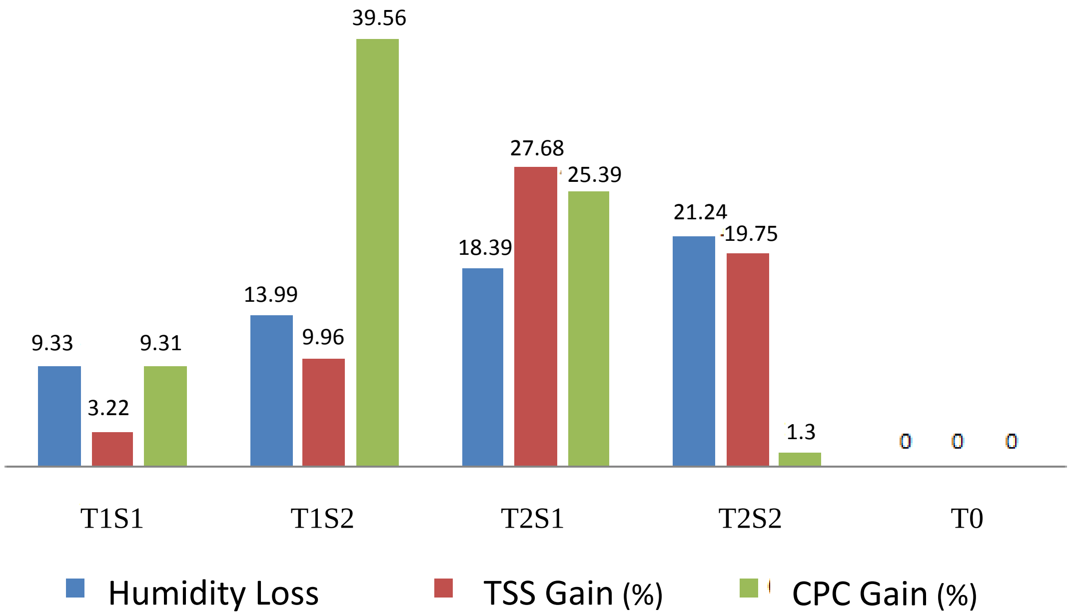

FIGURE 1. Gain ratio by TSS and CPC through partial dehydration of clusters.

The loss of water from the cluster above 9% was similar to those obtained by MORENO et al. (2008) and BELLINCONTRO et al. (2009). The gains from the concentration of total soluble solids and concentration of phenolic compounds did not affect the acidity of the must, demonstrating that the grape must may be adapted by heat treatment without necessarily performing sugaring.

CONCLUSION

The partial dehydration of the clusters had an influence on all variables assessed. In general, treatment T_2S_1 with 22.9 ^oC and air speed of 1.79 m s^{-1} was the most appropriate, presenting the highest value for the amount of total soluble solids, followed by the second best result for concentration of phenolic compounds. The other features are part of a range of value that does not interfere with the final destination of the must.

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