

Fermentative maceration time influences chromatic and phenolic composition of wines elaborate with the 'Bordô' grape

Tempo de maceração fermentativa influencia composição cromática e fenólica de vinhos elaborados com a videira 'Bordô'

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ABSTRACT

The aim of this study was to evaluate the effect of different fermentation maceration periods on the physicochemical, chromatic, and phenolic composition of wines made from the 'Bordô' vine. This work was carried out at the Fruit Growing Laboratory of the Federal Institute of Santa Catarina - Canoinhas Campus, in 2022. The 'Bordô' grape was harvested from a commercial vineyard, totaling five treatments consisting of different fermentation maceration periods: 02, 04, 06, 08 and 10 days. The wine was bottled in July 2022, after malolactic fermentation had finished, and the wines were evaluated ten days later. The analyses were carried out in triplicate, evaluating relative density, pH, total acidity, color intensity, color tone and total polyphenols. The data was submitted to analysis of variance and the means were compared using the Tukey test. The fermentation maceration period did not influence the color tone, total titratable acidity, relative density, and pH of the wines. In terms of total polyphenol content and color intensity, there was an increase in these variables as a function of the length of fermentation maceration. Therefore, the length of fermentation maceration influences the color and phenolic composition of wines made from the 'Bordô' grape.

KEYWORDS: *Vitis labrusca* L.; total polyphenols; color intensity; color shade.

RESUMO

Tem-se como objetivo deste trabalho avaliar o efeito de diferentes períodos de maceração fermentativa na composição físico-química, cromática e fenólica de vinhos elaborados com a videira 'Bordô'. O presente trabalho foi conduzido no Laboratório de Fruticultura do Instituto Federal de Santa Catarina – Campus Canoinhas, no ano de 2022. A uva 'Bordô' foi colhida em um vinhedo comercial, que consistem em diferentes períodos de maceração fermentativa: 02, 04, 06, 08 e 10 dias. O vinho foi envasado em julho de 2022, após término a fermentação malolática, e após dez dias após realizou-se as avaliações dos vinhos. As análises foram realizadas em triplicata, avaliando-se: densidade relativa, pH, acidez total, intensidade de cor, tonalidade de cor e polifenóis totais. Os dados serão submetidos à análise de variância e suas médias comparadas pelo teste de Tukey. O período de maceração fermentativa não influenciou a tonalidade de coloração, acidez total titulável, densidade relativa e pH dos vinhos. Em relação ao conteúdo de polifenóis totais e intensidade de cor, verificou-se aumento destas variáveis em função do aumento do período de maceração fermentativa. Portanto, o tempo da maceração fermentativa influencia na composição cromática e fenólica dos vinhos elaborados com a uva 'Bordô'.

PALAVRAS-CHAVE: *Vitis labrusca* L.; polifenóis totais; intensidade de cor; tonalidade de cor.

The region of Planalto Norte Catarinense has potential for viticulture, with a great possibility of generating income and employment, presenting favorable soil and climate conditions for growing grapes, intended for fresh consumption, making grape juice and table wines (WÜRZ et al. 2020). With the main

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objective of diversifying smallholdings, providing a new source of income for the producer (WÜRZ et al. 2021), with emphasis on the cultivation of vines of American origin, especially the 'Bordô' vine, which according to BRIGHENTI et al. (2018), has great market demand in the state of Santa Catarina.

The 'Bordô' (*Vitis labrusca*) vine (also known as 'Ives') is one of the main American cultivars produced in Brazil, and stands out for its high hardiness (HOFFMANN et al. 2005). In addition, its wines are deeply colored (ROBINSON et al. 2012). Wines and juices made with 'Bordô' grapes are marked by a "foxy" aroma, much appreciated by Brazilian consumers (CASTILHOS et al. 2016).

Although viticulture is an activity that has been carried out in the Planalto Norte Catarinense region, it is in recent years that there has been greater encouragement for the activity, and so there is little information on the oenological technologies used to make wine (SCHMIDT et al. 2022). According to SCHMIDT et al. (2023), the Planalto Norte Catarinense region may have the potential to produce wines with qualitative potential; however, care is needed, from the cultivation of the vines to the stages and care taken in the winemaking process.

With regard to oenological technologies, the period of fermentative maceration stands out. This is the contact between the grape skin and the must during alcoholic fermentation. This period can vary depending on the type of wine to be made (SOUSA et al. 2021), ranging from three to six days for young wines, according to GUERRA & BARNABÉ (2005). It is at this stage that the must incorporates, by contact, all the components retained in the skins, such as color components, basically made up of phenolic compounds (RIZZON & MANFROI 2006).

Greater control of certain stages of winemaking, especially maceration, can significantly influence the content of phenolic compounds and, consequently, the color of red wine (HEREDIA et al. 2010, GORDILLO et al. 2016). In addition, maceration time also has a direct influence on other parameters, such as pH and acidity, which determine the sensory and chemical balance of the wine (RIBÉREAU-GAYON et al. 2006, JACKSON 2014).

In a study carried out by SCHMIDT et al. (2022), it was found that in the Planalto Norte Catarinense region, 47.5% of producers carry out fermentative maceration for five days, and 21.7% for seven days. In addition, there are producers who macerate for two, three, four and six days, in other words, there is a wide variation between rural producers in the region, which may be directly related to a lack of technical information, since in a study carried out by WÜRZ & JASTROMBEK (2022), producers cite the lack of technical assistance as an obstacle to the progress and consolidation of the activity in this region. There is therefore a need for studies to indicate the best oenological technologies to be used by producers in the Planalto Norte Catarinense region.

Despite the importance of the maceration period for wine quality, there is no information in the literature on this stage of wine making, specifically for 'Bordô' vines. In this context, the aim of this study was to evaluate the effect of different fermentation maceration periods on the physicochemical, chromatic and phenological composition of wines made from the 'Bordô' vine.

This study was carried out in 2022, using the 'Bordô' grape variety from a commercial vineyard located in the municipality of Monte Castelo - Santa Catarina. The vineyard was planted in 2015 on the rootstock VR 043-43 with a density of 2.222 plants per hectare, in Y-shaped training system, presenting an average production of 20 tons per hectare. A total of 500 kg of grapes were harvested by hands, on February 1, 2022, when they reached a soluble solids content of 15 °Brix, totaling five treatments: 02, 04, 06, 08 and 10 days of fermentative maceration. After harvesting, the grapes were sent to the Fruticulture Laboratory of the Federal Institute of Santa Catarina - Campus Canoinhas, located in the municipality of Canoinhas - SC, to make the experimental wines.

Winemaking began on February 2, 2022, following a protocol adapted from PSZCZOLKOWSKI & LECCO (2011) and MAKHOTKINA et al. (2013). Destemming and extraction of the must were carried out manually, and 60 mg kg⁻¹ of SO₂ was added to the container containing the berries using a 10% solution of potassium metabisulphite. The berries from each treatment were divided into four replicates of equal volume (25 kg each container, totaling 100 kg of grapes for each maceration period) and placed in plastic fermenters fitted with hydraulic bungs, fermentation took place at a temperature of 20 °C. Active hydrated yeasts (*Saccharomyces cerevisiae*) were inoculated at a rate of 0.2 g.L⁻¹ four hours after the grapes were placed in the fermenters. Two pumping overs were carried out daily (08:00 and 18:00). After destemming and separating the wine from the pomace, the wine was racked four times (15th day, 45th day, 75th day and 120th day after destemming) until the end of malolactic fermentation was observed, and then bottled in July

2022 to carry out the chemical analysis of the samples.

The chemical analysis of the wines took place at the Fruticulture Laboratory of the Federal Institute of Santa Catarina - Campus Canoinhas, ten days after the wines were bottled, and the relative density, total titratable acidity (meq L⁻¹) and pH were evaluated, according to the methodology proposed by the *Office International de la Vigne et du Vin* (OIV 2016). The concentration of total polyphenols (TP) in the samples was determined by the spectrophotometry method described by SINGLETON & ROSSI (1965), using the Folin-Ciocalteu reagent (Vetec) and gallic acid as a standard, with absorbance readings at 760 nm. The color tone and intensity was determined using the spectrophotometry method described by RIZZON (2010). The extract was diluted in a 1:10 ratio and analyzed in a spectrophotometer at wavelengths of 420 nm, 520 nm and 620 nm. The color of the wines was measured by the parameters of color intensity and hue, obtained using the formulas: Intensity = 420 + 520 + 620 nm and Hue = 420/520 nm.

The analyses were carried out in triplicate, in a completely randomized design with four replicates in each treatment, and the data were submitted to analysis of variance and their means were compared using the Tukey test, adopting a 5% probability level, using the Sisvar 4.1 software.

Table 1 shows the effect of different fermentation maceration periods on the chemical composition of wines made from the 'Bordô' grape. It was observed that there was no influence of fermentative maceration on the relative density, total acidity and pH variables.

The relative density values ranged from 0.992 to 0.997, the total acidity ranged from 81.5 to 87.4 meq L⁻¹, while the pH variable ranged from 3.23 to 3.26. According to GIOVANNINI & MANFROI (2009), when fermentation is complete, the density of the wines can vary between 0.993 and 0.996, so all the treatments can be considered to have completed fermentation. Work carried out by ALVES et al. (2020), with different maceration periods, also found no effect of maceration time on the relative density of wines.

Regarding the total titratable acidity variable of red table wines, the ideal value should be between 55 meq L⁻¹ and 130 meq L⁻¹ (JACKSON 2014), and current Brazilian legislation establishes a minimum of 40 meq L⁻¹ and a maximum of 130 meq L⁻¹ for table wines, fine wines and noble wines (BRASIL 2018), so this variable is in accordance with current legislation and recommendations. Regarding the pH variable, according to ESTEBAN et al. (2002) there is a relationship between total acidity and pH, and although it is not a variable regulated by legislation, BENDER et al. (2017), emphasizes its importance in flavor and in the proportion between free and combined SO₂, and MORAES & LOCATELLI (2010), the ideal pH value ranges from 3.00 to 3.60, therefore, the values obtained in the present work can be considered adequate.

Table 1. Effect of different fermentation maceration times (days) on the chemical composition of wines made from the 'Bordô' grape.

Fermentation maceration time	Relative Density	Total Acidity (meq L ⁻¹)	pH
2 days	0,992 ns	84,4 ns	3,26 ns
4 days	0,995	86,5	3,23
6 days	0,996	81,5	3,23
8 days	0,997	87,4	3,24
10 days	0,997	82,5	3,26

ns = not significant by analysis of variance (ANOVA) at 5% error probability.

The effect of different fermentation maceration periods on color intensity, color tone and total polyphenols is described in Table 2. It was found that the color tone of the wines produced was not influenced by the maceration periods, with values observed ranging from 0.88 to 0.91. According to RIBÉREAU-GAYON et al. (2002), younger wines have color tones of between 0.5 and 0.7, while mature wines have values of between 1.2 and 1.3. In the context of this study, lower color tone values are desired, since according to ALMEIDA et al. (2023), lower color tone values are qualitative indicators.

However, there was an influence on the color intensity variable, which showed that increasing the fermentation maceration period resulted in greater color intensity in the wines. The lowest color intensity was observed for the two-day fermentation maceration period, with a value of 7.3, while the highest values were observed for fermentation maceration of eight and ten days, with values of 12.7 and 12.6, respectively. According to WÜRZ et al. (2021), the maceration period and number of pumping over can result in greater or lesser extraction of color from the skin of the grape berries, influencing the final intensity and color value of

the wine samples. Similar behavior was observed by ALVES et al. (2020), who observed an increase in the color intensity of wines with an increase in the fermentation maceration period.

Regarding the phenolic composition of the wines, it was found that the two-day fermentation maceration showed the lowest value for this variable, with a value of 1506.6 mg L⁻¹ gallic acid equivalent, with an increase to 1856.6 mg L⁻¹ gallic acid equivalent for the four-day fermentation maceration. The maceration periods of six, eight and ten days showed the highest values for total polyphenol content, with values of 1944.8, 1956.6 and 2010.2 mg L⁻¹ gallic acid, respectively.

In evaluations carried out by BRAGA (2015) on national red table wines, the total polyphenol contents found ranged from 1015 to 2159 mg L⁻¹. Therefore, the fermentation maceration period can significantly influence the increase in total polyphenol content, since according to LOOSE (2015), the winemaking process is directly related to variations in total polyphenols in wines. Maceration conditions have an impact on the phenomena of diffusion and dissolution of phenols, which are extracted from the cellular vacuoles of the skins (GONZALES-NEVES et al. 2008). Therefore, the duration of the maceration stage are conditions that influence the content of total polyphenols in wines (DAUDT & FOGAÇA 2013).

The longer the fermentation maceration period, the longer the period of contact between the grape skin and the must, and this significantly influences the content of total polyphenols. According to GIRARDELLO (2012), phenolic compounds are biosynthesized during the ripening of grapes, and most of these compounds are found in the skins and seeds. DAL'OSTO & MOTA (2012) observed that the extraction of total phenolic compounds also increased with maceration time.

Table 2. Effect of different fermentation maceration times (days) on the chromatic and phenolic composition of wines made from the 'Bordô' grape.

Fermentation maceration time	Color Intensity (420 + 520+ 620)	Color tone (420/520)	Total polyphenols (mg L ⁻¹ gallic acid)
2 days	7,3 c	0,91 ns	1506,68 c
4 days	9,8 b	0,92	1856,6 b
6 days	9,8 b	0,88	1944,8 a
8 days	12,7 a	0,89	1956,6 a
10 days	12,6 a	0,91	2010,2 a

*Means followed by the same letter in the row do not differ by the Tukey test at a 5% probability of error. ns = not significant by analysis of variance (ANOVA) at 5% probability of error.

Therefore, it can be concluded that: fermentation maceration time does not influence the color tone, total titratable acidity, relative density and pH of wines made from the 'Bordô' grape; Total polyphenol content is influenced by increasing fermentation maceration time, with higher values observed after six days of fermentation maceration; An increase in the fermentation maceration period results in an increase in the color intensity of the wines, with higher values for periods longer than eight days of fermentation maceration.

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