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# Evaluation of the enological potential of red grapes in southern Brazil

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**Abstract.** The campanha gaúcha is located in the pampa biome and has unique characteristics, as it is the hottest producing region with the lowest volume of rain in southern brazil. The present study sought to test these cultivars in the 2021 harvest, produced in the municipality of Dom Pedrito. During and after the winemaking process, analyzes of chromatic parameters were carried out by spectrophotometry, in addition to physical-chemical analyses. The sensorial characterization of these wines was also carried out, using quantitative descriptive analysis, through a panel of trained tasters. The alcoholic content varied considerably between the cultivars, with the lowest value presented by the alicante bouschet cultivar (9.5% v/v) and the highest level presented by the merlot cultivar (13.8% v/v), the other cultivars were in the range of 12% v/v. In relation to sensory analysis, the evaluators assigned aromatic descriptors to each variety, for petit verdot: strawberry, raspberry, cherry, toasted and plum in syrup. for merlot: pepper, plum, blackberry, smoked and red fruits. for alicante bouschet: plum, strawberry, cherry, mint and clove. And for touriga nacional: pepper, plum, blackberry, smoked and red fruits. Furthermore. As a conclusion, it can be highlighted that the tested cultivars have good oenological potential.

## 1. Introduction

According to EMBRAPA (2020), the Gaúcha Campaign is located in the pampa biome and has unique characteristics. It is the hottest producing region with the lowest volume of rain in southern Brazil. The large expanses of flat or low-slope areas are also a distinguishing feature of the Campanha Gaúcha. According to data from the latest Viticultural Registry (2015), the area of vineyards with varieties of Vitis vinifera from the Campaign totals 1,560 ha. Campanha Gaúcha is the second largest producer of fine wines in Brazil, accounting for 31% of production, coming after Serra Gaúcha, where 59% of national production is concentrated. In 2020, a major milestone occurred in this region, where the Gaúcha Campaign Indication of Origin seal was created. According to EMBRAPA (2020), to achieve this seal, the drink goes through a rigorous grape production phase in the delimited area, as well as in the elaboration, in which the requirements established in the Technical Specifications Booklet, which defines from the grape varieties authorized for winemaking until the tasting stage, when a panel of experts evaluates whether the wine can receive certification of conformity as a product of the Campanha Gaúcha Indication of Origin. IP Campanha Gaúcha includes the cultivation of 36 varieties produced in the region, including Touriga Nacional, Merlot, Alicante bouschet and Petit Verdot. Both varieties are also present in the municipality of Dom Pedrito, Campanha Gaúcha region, where the Federal University of Pampa has an experimental vineyard implemented in 2014, which includes 40 wine varieties, in an espalier training system, in which the student learns different practices from planting until harvest. In this context, the objective of this work was to evaluate the oenological suitability of cvs. Touriga Nacional, Merlot, Alicante Bouschet and Petit Verdot in the municipality of Dom Pedrito/RS..

## 2. Metodology

This research was developed in the Bachelor's Degree in Enology of the Federal University of Pampa (UNIPAMPA), Dom Pedrito campus, located in the municipality of Dom Pedrito, Rio Grande do Sul, Brazil. The varieties Vitis vinifera ‘Alicante Bouschet’, ‘Merlot’, Petit Verdot and Touriga Nacional were used for the study. These varieties are produced in the experimental vineyard of UNIPAMPA, located on BR 293, km 238, where both varieties are trained in the espalier system, with a spacing between rows of 2.5 m and 1 m between plants, and the vineyard is managed with the help of students of the Bachelor's Degree in Enology. The grapes were destemmed and crushed, at which time a sample of must

was collected for physical-chemical analysis of the must. The must with the skins was then transferred to 14 L carboys, where each variety was divided into biological triplicates (R1, R2 and R3). Subsequently, sulfitation was carried out with the addition of 50 mg.L of sulphur dioxide (in the form of Potassium Metabisulfite) to prevent contamination and oxidation; 15 minutes later, enzymatic treatment was carried out, using the Colorpect VRC® Enzyme at a dose of 2 g.hL in each 14 L carboy, to increase colour extraction and increase wine yield. The dosage of the inputs was identical for both varieties. After the process, all the carboys were taken to a refrigerated room to begin pre-fermentation maceration for 24 hours without yeasts, thus favouring the extraction of aromas and anthocyanins. The following day, all the bottles were taken to the fermentation room, 36 maintained at a temperature of 20°C, where 20 g.hL of Gesferm® was added to each bottle to stimulate fermentation and AWRI 796® yeast was inoculated at a dose of 25 g.hL. This yeast, according to the manufacturer, produces low levels of aroma and flavor compounds and is considered a relatively neutral yeast, used to enhance varietal aromas (AMAZON GROUP, 2021). Over the course of the days, densities, temperature, tasting, and open pumping over and treading were monitored, alternating in the morning and evening for all wines, to check whether fermentation was occurring correctly. Tasting was performed daily to evaluate the color and characteristics of the wine, in addition to checking for any defects. On the seventh day, Actimax® was added at a dose of 10g.hL as an alcoholic fermentation activator, and the bottles were taken to the winemaking pavilion, where they remained with their skins at a temperature of 26°C to promote the end of fermentation. The following day, the wines were uncorked (after 8 days), and then the alcoholic fermentation was monitored until its completion, to produce a traditional wine. Once the alcoholic fermentation was complete, verified by the density that remained below 1000 for three consecutive days, the wine was decanted for 24 hours to separate the thick lees, then it was transferred to 4.6 L full bottles, closed with a Muller valve, which was used to limit the entry of oxygen. Malolactic fermentation occurred spontaneously and was monitored through physical-chemical analyses to verify whether the malic acid had already been degraded, noting that it ended on the 60th day for all wines. The wines were racked and $SO_2$ (potassium metabisulfite) was corrected at a dose of 50 mg.hL-1 in each bottle, which was topped up and then stored in a refrigerated room at a temperature of 16°C. The wines were then bottled 5 months after receiving the grapes, and SO2 was corrected at a dose of 30 mg.hL, being placed individually in each bottle to avoid contamination that may occur after bottling. After bottling (figure 10), the wines were stored in plastic boxes at the experimental winery at UNIPAMPA, to be sensorially analyzed in the following days.

The physical and chemical analyses were performed in the laboratories of UNIPAMPA – Campus Dom Pedrito-RS, where the WineScan SO2® equipment (FOSS, Denmark) and the FOSS integratorversion 1.6.0 software (FOSS, Denmark) were used, which uses the Fourier transform infrared spectrometry (FTIR) technique, spectrophotometer 200ª. The physical and chemical analyses of the must and wine were performed using the WineScan, with the response variables being pH, density, total acidity, glycerol, reducing sugars, tartaric acid, malic acid, lactic acid, gluconic acid, potassium and alcohol. The index of polyphenols, free anthocyanins, intensity and color tone were analyzed using a spectrophotometer 200ª. The color intensity was based on the method of Zamora (2003). To evaluate the sensory characteristics of the wines produced, the sensory analysis was developed in a room at the Universidade Federal do Pampa (UNIPAMPA), Dom Pedrito campus, with 9 tasters in the morning and 10 different tasters in the afternoon, all of whom had at least 3 years of experience and were competent to evaluate the different samples. One repetition of each wine was analyzed per shift, without identifying the variety, containing only three digits at the time of service, and the wines were served at a temperature of 20°C. In the morning shift, repetition 1 of both varieties was analyzed, and in the afternoon shift, repetition 2 of the same varieties.

## 3. Results and discussion

Observing some of the main physical-chemical analyses of the wines that were analyzed in the Table 1, such as alcohol, there was considerable variation among the 4 cultivars. In the Alicante Bouschet wine, the alcohol followed a pattern compared to the study carried out by Dachi (2015) which obtained an alcohol content of 9.9% v/v, with the same variety. In the Merlot grape wine, a remarkable value in the alcohol content of 13.8% v/v was observed, due to the good maturation of the grape in the 2021 harvest, compared to the work carried out by Togores (2011) who obtained a wine with an alcohol content of 11.5% v/v, where it was possible to increase to 12.5% v/v after being chaptalized. Regarding the Petiti Verdot and Touriga Nacional cultivars, both were just above 12.5% in alcohol content. The malic and lactic acid contents show that the wines underwent malolactic fermentation. Due to MLF, the reduction in total acidity is also notable, which for red wines is within the desired standards. The parameters found in this table would indicate a traditional red wine, with a marked acidity and a certain body, which can favor storage. Based on the standard deviation, which was less than 5%, we can demonstrate the methodological quality of the research.

Volatile acidity (which is an undesirable acidity in wines in general) remained at ideal levels for the quality of the product, being considered low, which confirms the health of the grapes. As for glycerol (a polyalcohol formed at the beginning of fermentation), which is a determining factor for the quality of the product, since it gives smoothness to the wine, it had a value of 8.6 g.L-1. Regarding the standard deviation, the wine had little variation in its parameters, since all are less than 0.5. The wines underwent malolactic fermentation. The main result of MLF is the conversion of malic acid into lactic acid. After the end of the MLF, a reduction in the total acidity of the wine was observed, to 97.3 meq.L-¹ and an increase in pH

to 3.37, in addition to microbiological stabilization and production of compounds related to the aroma and flavor of the final product. The ideal pH for this variety is 3.5; under the conditions of this experiment, the pH 46 presented a value close to 3.65, and the acidity also fits within the limits established by Brazilian legislation, which is 40 to 130 meq.L-1, maintaining the standard for the variety (Zamora, 2003). The volatile acidity value is low, 0.6, confirming that there was no contamination in the grape, although visually the grape already showed signs of dehydration. As for glycerol, which is a determining factor for the quality of the product, since it gives smoothness to the wine, which is formed depending on the concentration of sugars in the must, the strain of yeast, the pH, among others, it had a value of 13.15 g.L-1. The residual sugar content shows that the alcoholic fermentation was completed. The main result of MLF is the conversion of malic acid into lactic acid (LYU, 2021). With MLF, there is a reduction in the total acidity of the wine, to 87.3 meq.L-1 and an increase in pH to 3.65, in addition to microbiological stabilization and production of compounds related to the aroma and flavor of the final product, after the end of the process. The results presented above (table 4) are within a standard of identity and quality established by current legislation. None of the wines presented any change that could be considered a defect or failure in the winemaking process. The Touriga Nacional wine, in relation to the index, could be intended for young wines, and the Petit Verdot wine, the index indicates a more structured wine, with more tannins according to the results obtained. The total polyphenol index (TPI) establishes the overall concentration of phenolic compounds in wines, an important variable for monitoring wine maturation (GABBARDO, 2009). As the skin comes into contact with the juice during the fermentation stage, during the production of red wine, the phenolic compounds pass from the skin to the juice, leaving a high index of total polyphenols in the juice (Ribéreau-Gayon et al., 2006). According to data obtained in analyses carried out using a spectrophotometer, it can be observed that Alicante Bouschet wines have the potential to be aged in oak. In Merlot wines, the TPI was lower, which is why barrel aging is not recommended. The total polyphenol index is a simple analysis carried out using an ultraviolet light spectrophotometer. We know that we need minimum IPT values of 60 or 70 to be able to think about taking the wine to oak barrels, otherwise it is better to leave it in the stainless steel tank

The aromatic descriptors were very diverse showed at te Table 2, with the most noticeable for tasters being the fruity sensation, in addition to “spices” and “sweet”, which were the most described. The most cited aromatic descriptors for the wine of the ‘Alicante Bouschet’ variety were plum, strawberry, cherry, mint, clove and spices, some typical aromas found in this variety. According to Pizzato (2009), its aromas vary according to the producing region, including ripe dark fruits (raisins, plums, dates, currants, blueberries), vegetal notes, leather, eucalyptus, black olives, cinnamon, pepper and anise. The wine of the ‘Merlot’ variety stood out in the most cited aromatic descriptors such as pepper, plum, blackberry, smoked and red fruits, which can be found in the variety descriptors. In aromas, Merlot presents intense and fresh notes of red fruits such as strawberry, raspberry and blackberry.

Regarding the Touriga Nacional and Petiti verdot cultivars, it can be noted that the families that appeared most in both wines were red fruits and notes such as strawberry, raspberry, cherry and blackberry. And the spice group where notes such as clove, cinnamon, as well as smoky notes were frequently cited. The compound responsible for the clove aroma is one of the main volatile phenol compounds, eugenol, this compound affects red wines more (FERREIRA, 2009). The compound responsible for the strawberry aroma is butyl butanoate, an ester, just like isobutyl methanoate, the compound responsible for the raspberry aroma. Esters have a great impact on the wine, giving rise to fruity aromas. The aromas that have been described may have been generated by the yeast used in winemaking.

**Table 1.** Averages of the analytical results of the replicates evaluated in each cultivar.

| | **Wines produced** | | | |
|---|---|---|---|---|
| **Parameters** | **Alicante Bouchet** | **Merlot** | **Touriga Nacional** | **Petit Verdot** |
| Alcohol (%) | 9,5 ± 0,5 | 13,8 ± 0,3 | 12,6 ± 0,1 | 12,5 ± 0,1 |
| Total Acidity (Meq.L-1) | 97,3 ± 1,0 | 87,0 ± 0,5 | 94,6 ± 1,0 | 101,3 ± 1,0 |
| pH | 3,37 ± 0,1 | 3,65 ± 0,1 | 3,63 ± 0,1 | 3,56 ± 0,1 |
| Volatile acidity (g.L-1 acid acetic) | 0,55 ± 0,1 | 0,6 ± 0,01 | 0,6 ± 0,01 | 0,5 ± 0,01 |
| Sugar (g.L-1) | 2,65 ± 0,1 | 3,2 ± 0,1 | 3,35 ± 0,1 | 1,9 ± 0,1 |
| Glycerol (g.L-1) | 8,6 ± 0,3 | 13,15 ± 0,4 | 11,9 ± 0,1 | 10,0 ± 0,1 |
| Malic Acid (g.L-1) | 0,15 ± 0,1 | 0,85 ± 0,9 | 0,4 ± 0,2 | 0,4 ± 0,2 |
| Latic Acid (g.L-1) | 1,85 ± 0,1 | 0,9 ± 0,7 | 2,05 ± 0,1 | 2,3 ± 0,1 |
| Folin C Index | 72,1 ± 1,21 | 53,1 ± 3,8 | 40,75 ± 1,0 | 38,3 ± 1,0 |
| Color intensity | 3,37 | 2,30 | 2,72 | 1,93 |

**Table 2.** Aroma families and main descriptors perceived in wines by tasters.

| | **Wines produced** | | | |
|---|---|---|---|---|
| **Parameters** | **Alicante Bouchet** | **Merlot** | **Touriga Nacional** | **Petit Verdot** |
| Red fruits | 24 | 20 | 18 | 27 |
| Floral | 2 | 4 | 1 | 1 |
| Smoked | 3 | 11 | 5 | 5 |
| Spices | 7 | 6 | 7 | 4 |
| Sweet | 4 | 8 | 17 | 8 |
| Earthy | 0 | 0 | 0 | 2 |
| Defects | 0 | 0 | 0 | 2 |
| 5 most cited descriptors | Plum, strawberry, | | | |

## 4. Conclusion

The Touriga Nacional and Petit Verdot grapes produced in Dom Pedrito in the 2021 harvest show oenological potential. The physical-chemical characteristics of the wines were analyzed and they comply with Brazilian legislation. The sensory characteristics demonstrated quality of the wines and their main aromatic descriptors were: Plum in syrup, strawberry, cherry, clove, cinnamon, tobacco, toasted. However, further studies of these varieties are suggested for better characterization and evaluation, as this is a pioneering work on the suitability of these varieties from the experimental vineyard of the Federal University of Pampa in the municipality of Dom Pedrito-RS.

The Alicante Bouschet and Merlot wines have oenological potential in the municipality of Dom Pedrito with a rainy year. The sensory characteristics were positive and the aromatic descriptors identified for Alicante Bouschet stood out as plum, strawberry, cherry and mint, with no identified defects, and for Merlot, pepper, plum, blackberry and smoked stood out, also without defects, thus considering quality in both wines. Polyphenol levels and color intensity are similar to those found by other authors.

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