Physicochemical characteristics of the Brazilian Cabernet Sauvignon wine as a function of the vintage

Luiz Antenor Rizzon and Alberto Miele
Embrapa Uva e Vinho, Bento Gonçalves, RS, Brazil
E-mails: rizzon@cnpuv.embrapa.br; miele@cnpuv.embrapa.br

Key words: wine, viniculture, vintage, Cabernet Sauvignon, Brazil.

Abstract

The objective of this work was to evaluate the physicochemical composition of the Cabernet Sauvignon wine from the Serra Gaúcha, the Brazilian most important viticultural region. It was carried out during the 1999, 2000 and 2001 vintages. From each grower, 60 kg of ripened grapes were sampled and crushed, and wines were made in glass recipients of 20 L. Results show that wine made with Cabernet Sauvignon grapes from the 1999 vintage was characterized by the lowest alcohol degree and the highest values of total acidity, reduced dry extract, anthocyanins, A420, A520 and color intensity; those from 2000, the highest alcohol degree and the lowest total acidity and reduced dry extract; wines from 2001 had the highest values for pH, ashes, ashes alkalinity, volatile acidity, P and K, and the lowest for most volatile compounds.

Introduction

The production of grapes in Brazil is concentrated in Rio Grande do Sul, the southern state of the country. The average annual production is about 600 thousand tons/year, most of them come from the Serra Gaúcha viticultural region which originates about 90% of the Brazilian wine and 95% of the grape juice. The vineyard surface is about 35 thousand hectares, cultivated by 15 thousand families. Considering this panorama, American and hybrid varieties predominate but Cabernet Sauvignon is the most important red wine variety. In this way, the vitiviniculture represents an important economic and social agriculture segment.

Serra Gaúcha is a mountainous region, in general characterized by fertile soils and high rainfall. These conditions transmit vigor and high yields to grapevines, that is not desirable for good quality wines. To try to solve this problem, grape growers and winemakers adopted some of the modern technologies, which improved wine quality specially from the 1970s. Besides, some researches were carried out to better understand the Cabernet Sauvignon behavior in this region and to improve its quality. Among these works, it is interesting to emphasize those of Rizzon and Miele (1997), Dall'Agnol et al. (2001), Miele and Rizzon (2003), Miele et al. (2005) and Santos et al. (2005). More specifically, the composition of the Cabernet Sauvignon wine was object of study by the works of Rizzon and Miele (1997, 2002) and the climatic factors in the Serra Gaúcha were analyzed by Mandelli (1999, 2000, 2001). But still there are many subjects to be considered by producers and researchers.

It is important to characterize wine because it allows to typify the regional products and to define wine quality parameters. The knowledge of the physicochemical composition of the Cabernet Sauvignon wine as a function of the climatic conditions of each vintage is important to the researchers direct works to improve grape and wine quality. Besides this, wine, wineries and the Serra Gaúcha viticultural region acquire credibility.

Material and Methods

The experiment was carried out during the 1999, 2000 and 2001 vintages. Sixty kilograms of ripened Cabernet Sauvignon grapes of two growers of each area considered in this experiment were sampled and crushed. The areas were Bento Gonçalves, Farroupilha, Flores da Cunha, Garibaldi and Monte Belo do Sul.

Wine was made in duplicate in glass recipients of 20 L of capacity. Fifty mg/L of a 5% SO_2 solution was added to the must before fermentation. To perform the alcoholic fermentation, it was used a dry active yeast of *Saccharomyces cerevisiae* in the concentration of 20 g/hL. Grapes were macerated for five days with two pumping over/day. There was no must sugar correction. When alcoholic and malolactic fermentation were over, wines were racked, stabilized and bottled.

Thirty-eight variables were evaluated which were related to physicochemical, volatile substances and mineral composition of Cabernet Sauvignon wine. Density was determined by a digital densimeter; alcohol, by distillation and densimetry; pH, by a digital pHmeter having a glass electrode and calibrated with standard solutions of pH 3.0 and 4.0; total acidity, by wine titration using a 0.1N NaOH solution and bromothymol as indicator; volatile acidity, by steam distillation and titration with a 0.1N NaOH solution and phenolphthalein as indicator; reducing sugars were analyzed according to the methodology of Meyer and Leygue-Alba (1991); dry extract and reduced dry extract, by Ribéreau-Gayon et al. (1982); ashes, by the incineration of 20 mL of wine where the temperature varied from 530ºC to 550ºC (Amerine and Ough, 1976); ashes alkalinity, by Usseglio-Tomasset (1995); anthocyanins, by Ribéreau-Gayon and Stonestreet (1965); tannins, by Ribéreau-Gayon and Stonestreet (1966); color indices – measuring absobance at 420 and 520 nm –, color intensity and hue, by Ribéreau-Gayon et al. (1982); and proline, by Gianessi and Matta (1987).

Most minerals were analyzed using a Perkin-Elmer atomic absorption spectrophotometer: Ca, Mg, Mn, Fe, Cu and Zn were determined by atomic absorption; K, Na and Rb by flame emission (Perkin-Elmer, 2000). P was analyzed according to the methodology of Tedesco et al. (1995) adapted to the analysis of must and wine.

Volatile compounds were determined according the methodology of Bertrand (1975), using a gas chromatograph equipped with an ionization flame detector and the 4-methyl-2-pentanol as internal standard. For glycerol determination, a flame ionization detector was used and the internal standard was the 1,6-hexanediol (Cantagrel et al., 1978).

Results

Results show that there were no striking differences of Cabernet Sauvignon wines made in different vintages of the Serra Gaúcha viticultural region. Nevertheless, most variables showed differences among years (Tables 1, 2, and 3).

In 1999, Cabernet Sauvignon wines were characterized by a lower alcohol degree and pH and a higher total acidity (Table 1). These values were affected by the climatic conditions during grape ripening and maturation. Indeed, this year was characterized by a dry period that had influence on the vegetative development and grape maturation. Nevertheless, besides a lower alcohol content, dry extract and reduced dry extract were higher than those from the 2000 vintage. This was probably due to the solubilization of the skin and seed compounds during vinification and to the higher glycerol concentration in the 1999 Cabernet Sauvignon wine.

Wine from the 2000 vintage had the highest alcohol value, which indicates a better grape maturation although rain was higher than the average in January and March. In this sense, it means that February could have had an important effect on grape maturation. It was also observed a lower value of reduced dry extract in relation to the alcohol degree, which directed to a higher value of the variable alcohol in weight/reduced dry extract. Another aspect to be

considered in this year is the higher tannin concentration, that was probably due to the a greater extractability during vinification.

In 2001, wine was characterized by higher values of pH, volatile acidity, ashes, ashes alkalinity and proline. The pH is a consequence of the free tartaric acid concentration and its transformation in its salt form, that is correlated to the ashes and ashes alkalinity. The highest value of volatile acidity is in accordance to the Brazilian legislation, but it shows that it could have some problem with grape health in this year.

TABLE 1. Physicochemical composition of Cabernet Sauvignon wine from different vintages of the Serra Gaúcha viticultural region, Brazil.

Variable	Year			Average	Standard deviation
	1999	2000	2001		
Density (mg/mL)	0.9962	0.9953	0.9964	0.9960	0.0006
Alcohol (% v/v)	9.92	10.50	10.00	10.14	0.31
pH	3.49	3.59	3.80	3.63	0.16
Total acidity (meq/L)	88.4	73.4	75.0	78.9	8.2
Volatile acidity (meq/L)	8.3	8.8	11.3	9.5	1.6
Tartaric acid (g/L)	2.80	3.30	3.10	3.05	0.35
Reducing sugars (g/L)	2.03	2.31	2.30	2.21	0.16
Dry extract (g/L)	20.69	19.70	20.80	20.40	0.61
Reduced dry extract (g/L)	19.67	18.39	19.50	19.19	0.70
Alcohol/Reduced dry extract	4.04	4.55	4.10	4.23	0.28
Ashes (g/L)	2.56	2.55	2.90	2.67	0.20
Ashes alkalinity (meq/L)	30.9	28.1	35.5	31.4	0.7
Glycerol (g/L)	11.5	10.0	10.4	10.6	0.8
Proline (mg/L)	509	774	901	728	200
Anthocyanins (mg/L)	355	332	203	296	82
Tannins (g/L)	1.39	1.46	1.00	1.28	0.25
A420	0.317	0.267	0.200	0.261	0.059
A520	0.582	0.406	0.300	0.429	0.142
Color intensity	0.898	0.672	0.600	0.723	0.156
Hue	0.558	0.662	0.700	0.640	0.074

In general, Cabernet Sauvignon wine showed higher concentrations of higher alcohols specially those of 2-methyl-1-butanol and 3-methyl-1-butanol (Table 2). This result could be directly related to the nitrogen substances present in the must. Ethyl acetate was higher in 2001, which corresponds to the highest volatile acidity registered in this year. Wine from 1999 had higher concentration of 1-propanol that could be related to the threonine concentration in the must which is a precursor of this alcohol. The higher value of 2-methyl-1-propanol in 2001 could be associated to a higher concentration of valine.

Cabernet Sauvignon wine from 2001 vintage was characterized by a higher concentration of minerals. K, a cation presents in the highest concentration, have a direct influence in wine characteristics because it increases pH and ashes alkalinity values. Although the final concentration of these mineral elements depends on wine ionic equilibrium, their concentration is affected by the climatic conditions, cultural practices used in the vineyard and processes of winemaking.

In relation to the climatic conditions, 1999 was characterized by dry conditions, i.e., rainfall was lower than the normal, especially in the period of Cabernet Sauvignon ripening. The water deficiency of this period had effect on the grapevine vegetative development and

on grape maturation. In contrast, 2000 presented the highest precipitation in January and March, but lower in February. Besides, this year showed greater number of days with rainfall. In 2001, December and January showed higher humidity and lower precipitation during February and March. In addition, this year was characterized by a lower insolation in January and February.

TABLE 2. Volatile substances of Cabernet Sauvignon wine from the Serra Gaúcha viticultural region, Brazil.

Variable (mg/L)	Year			Average	Standard deviation
	1999	2000	2001		
Ethyl acetate	55.2	32.6	61.2	49.7	15.1
Methanol	143.3	125.1	137.4	135.3	9.3
1-Propanol	36.7	24.0	21.5	27.4	8.2
2-Methyl-1-propanol	46.0	49.2	73.8	56.3	15.2
2-Methyl-1-butanol	81.9	85.2	69.7	78.9	8.2
3-Methyl-1-butanol	260.8	269.3	195.9	241.9	40.1
Sum of higher alcohols	425.4	425.6	361.5	403.8	37.0

TABLE 3. Mineral composition of Cabernet Sauvignon wine from the Serra Gaúcha viticultural region, Brazil.

Variable (mg/l)	Year			Average	Standard deviation
	1999	2000	2001		
P	70.4	93.9	129.2	97.8	29.6
K	1156	1224	1429	1270	142
Ca	74.9	70.7	83.3	76.3	6.4
Mg	70.1	90.4	94.8	85.1	13.2
Na	4.00	4.30	5.40	4.57	0.74
Mn	2.10	2.60	2.00	2.23	0.32
Fe	1.70	2.10	2.00	1.93	0.21
Cu	0.20	0.30	0.20	0.30	0.06
Zn	0.30	0.60	0.70	0.53	0.21
Rb	7.10	8.00	8.40	7.83	0.67

Conclusion

The climatic conditions during the grape ripening and maturation had effect on the Cabernet Sauvignon wine, especially in the 1999 vintage, where the conditions were dryer than 2000 and 2001. The wine physicochemical composition from the 1999 was in accordance with the climatic parameters registered in that year, specially those related to the variables dry extract and phenolic compounds, such as anthocyanins, A420, A520, color intensity and hue.

References

AMERINE, M. A.; OUGH, C. S. **Análisis de vinos y mostos**. Acribia: Zaragoza, 1976.

BERTRAND, A. **Recherches sur l'analyse des vins par chromatographie en phase gazeuse**. Thèse (Doctorat d'État) - Institut d'Oenologie, Université de Bordeaux II, Talence, 1975.

CANTAGREL, R; SYMONDS, P; CARLES, J. Dosage du glycérol dans les vins par chromatographie en phase gazeuse. **Revue Française d'Œnologie,** n.72, p.37-39, 1978.

DALL'AGNOL, I.; MIELE, A.; RIZZON, L. A. Effet du passerillage du raisin sur le vin: premiers résultats des essais au brésil. In: WORLD CONGRESS OF THE OFFICE INTERNATIONAL DE LA VIGNE ET DU VIN, 26., 2001, Adelaide. **Proceedings...** Adelaide: Office International de la Vigne et du Vin, 2001. p. 119-127.

GIANESSI, P.; MATTA, M. **Trattato di scienza e tecnica enologica**: analisi e controllo dei mosti e dei vini. Brescia: AEB, 1987. v.1.

MANDELLI, F. **Comportamento meteorológico e sua influência na vindima de 1999 na Serra Gaúcha**. Bento Gonçalves: Embrapa Uva e Vinho, 1999. (Comunicado Técnico, 34).

MANDELLI, F. **Comportamento meteorológico e sua influência na vindima de 2000 na Serra Gaúcha**. Bento Gonçalves: Embrapa Uva e Vinho, 2000. (Comunicado Técnico, 35).

MANDELLI, F. **Comportamento meteorológico e sua influência na vindima de 2001 na Serra Gaúcha**. Bento Gonçalves: Embrapa Uva e Vinho, 2001. (Comunicado Técnico, 40).

MEYER, C. R.; LEYGUE-ALBA, N. M. R. **Manual de métodos analíticos enológicos**. Caxias do Sul: UCS, 1991.

MIELE, A.; RIZZON, A. Effet du système de conduite sur la composition du vin Cabernet-Sauvignon au Brésil: prémiers résultats. In: SYMPOSIUM INTERNATIONAL D'OENOLOGIE, 7., 2003, Arcachon. [**Comptes Rendues...**]Paris: Tc & Doc, 2003. p. 152-154.

MIELE, A.; RIZZON, L. A.; SÔNEGO, O. R.; GARRIDO, L. da R. Effect of *Glomerella cingulata* on the physicochemical composition of Cabernet Sauvignon wine. **American Journal of Enology and Viticulture**, v. 56, n. 3, p. 307A, 2005.

PERKIN-ELMER. **Analytical methods for atomic absorption espectrophotometry**. Singapura: Perkin-Elmer, 2000.

RIBÉREAU-GAYON, J.; PEYNAUD, E.; SUDRAUD, P.; RIBÉREAU-GAYON, P. **Traité d'œnologie**: sciences et techniques du vin: analyse et contrôle des vins. 2.éd. Paris : Dunod, 1982. v.1.

RIBÉREAU-GAYON, P.; STONESTREET, E. Dosage des tanins du vin rouge et détermination de leur structure. **Chimie Analytique**, v. 48, n. 4, p.188-196, 1966.

RIBÉREAU-GAYON, P.; STONESTREET, E. Le dosage des anthocianes dans le vin rouge. **Bulletin de la Societé Chimique de France**, v. 9, n. 419, p.2649-2652, 1965.

RIZZON, L. A.; MIELE, A. Avaliação da cv. Cabernet Sauvignon para elaboração de vinho tinto. **Ciência e Tecnologia de Alimentos**, v. 22, n. 2, p. 192-198, 2002.

RIZZON, L. A.; MIELE, A. Caractéristiques analytiques des vins au Brésil. In: ANALYTICA SCIENTIA, 1., 1997, Bordeaux. **Livre des Résumés...** Bordeaux: Fédération Européenne des Societés Chimiques: Societé Française de Chimie: Organization Internationale de la Vigne et du Vin, 1997. p.478-481.

SANTOS, B. A. C. dos; SILVA, M. A. A. P. da; MIELE, A.; FRANCO, M. R. B. The impact of geographic origin on the sensory profile and acceptance of Brazilian Cabernet Sauvignon wines. In: PANGBORN SENSORY SCIENCES SYMPOSIUM, 6., 2005, Arrogate. **Abstract Book...** London: Campden & Chorleywood Food Research Association Group: Elsevier, 2005. v. 1, p. 111.

TEDESCO, M. J.; GIANELLO, C.; BISSANI, C. A.; BOHNEN, H.; VOLKWEISS, S. **Análises de solo, plantas e outros materiais**. 2.ed. Porto Alegre: UFRGS, 1995.

USSEGLIO-TOMASSET, L. **Chimica enológica**. 4.ed. Brescia: AEB., 1995.