Quality of Brazilian red wines according to their geographical and varietal origin

Alberto Miele[(1)], Mauro Celso Zanus[(1)] and Luiz Antenor Rizzon[(1)]
[(1)]Embrapa Uva e Vinho, Caixa Postal 130, 95700-000 Bento Gonçalves, Brazil
miele@cnpuv.embrapa.br; zanus@cnpuv.embrapa.br; rizzon@cnpuv.embrapa.br

ABSTRACT

This work evaluated the physicochemical composition of 171 red Brazilian wines from the 2006 vintage, which were represented by 21 varietals. These wines were made by 58 wineries spread over the country with latitudes varying from 9° to 31° South. The physicochemical wine analysis was performed in 2006 and the discrimination among the geographical origin and the varietal wines was done by means of the principal component analysis (PCA). Main results show that wines from the Vale do São Francisco viticultural region had higher values of potassium, pH, density and volatile acidity; from São Joaquim, by higher values of A420, A520, A620, color intensity, total phenolic compounds, anthocyanins and dry extract while those from Toledo had lower values of these variables; from Serra do Nordeste A, by higher titratable acidity; and from Planalto Superior B, by a higher hue. Regarding the varietal wines, the PCA mainly discriminated wines made from the verities Ancellotta, Teroldego, Egiodola, Refosco, Marselan, Cabernet Sauvignon, Pinotage, Pinot Noir, Malbec, Arinarnoa, Barbera and Alfrocheiro.

RÉSUMÉ

Ce travail a évalué la composition physico-chimique de 171 vins rouges Brésiliens faits en 2006 avec 21 variétés de raisin. Ces vins ont été élaborés par 58 maisons localisées dans sept régions viticoles du pays avec des latitudes variant de 9° à 31° Sud. L'analyse physico-chimique a été faite en 2006 et la discrimination entre les régions viticoles et les vins variétaux a été faite par l'analyse en composantes principales (ACP). Les principaux résultats montrent que si on considère les régions viticoles, les vins issus du Vale do São Francisco ont eu des valeurs plus élevés de potassium, pH, densité et acidité volatile; ceux de São Joaquim, plus élevés des indices A420, A520 et A620, intensité de couleur, composés phénoliques totaux, anthocyanes et extrait sec. Par contre, ceux de Toledo ont présenté des valeurs plus bas de ces variables; ceux de la Serra de Nordeste A, par une plus intense acidité totale; et ceux du Planalto Superior B, par une coloration plus élevée. Par rapport aux vins variétaux, l'ACP a discriminé les vins faits avec les variétés Ancellotta, Teroldego, Egiodola, Refosco, Marselan, Cabernet Sauvignon, Pinotage, Pinot Noir, Malbec, Arinarnoa, Barbera et Alfrocheiro.

INTRODUCTION

The annual Brazilian grape production is over one thousand tons, half sold as table grape and the other half as grape for processing. Considering this late segment, wine is important due to the added value it transfers to the wineries.

Nevertheless, the Brazilian wine industry has low competitiveness and it suffers attack of wines produced in other regions, such as Chile, Argentina and European countries, by means of the globalization effect. To mitigate this effect, it is necessary to improve wine competitiveness, which could be reached with quality and price. In this way, some actions are being taken by wine producers and wine sellers.

Considering this context, this work had the objective to discriminate Brazilian red wines coming from seven different viticultural regions and to discriminate varietal wines made from 21 wine grape varieties.

MATERIAL AND METHODS

Wines represented seven different viticultural regions of the country, spanning from 9° South to 31° South. The 171 varietal wines were made with 21 grape varieties by 58 wineries. They were made and analyzed during the 2006 vintage. Wine samples were directly collected in the wineries from inox tanks or oak barrels. These wines took part of the National Wine Evaluation, event annually promoted by the Associação Brasileira de Enologia (ABE).

The viticultural regions considered in this work were: São Joaquim (SJ), in the state of Santa Catarina; Toledo (T), in the state of Paraná; Vale do São Francisco (SF), in the states of Pernambuco and Bahia; Serra do Nordeste A (SNA), Serra do Nordeste B (SNB), Planalto Superior B (PSB) and Campanha B (CB), in the state of Rio Grande do Sul. These four late regions were classified according to the studies conducted and published during the 1990 decade, which classify the state in agroecological regions (Rio Grande do Sul, 1994; Maluf and Westphalen, 1999).

The 21 wines were made from varieties originated in France (11), Italy (4), Portugal (3), South-Africa (1), Spain (1) and United States (1). These varieties were: Alfrocheiro (ALF), Ancellotta (ANC), Arinarnoa (ARI), Barbera (BAR), Cabernet Franc (CFR), Cabernet Sauvignon (CSA), Carmenère (CAR), Egiodola (EGI), Malbec (MAL), Marselan (MAR), Merlot (MER), Periquita (PER), Pinot Noir (PNO), Pinotage (PTE), Refosco (REF), Ruby Cabernet (RCA), Syrah (SYR), Tannat (TAN), Tempranillo (TEM), Teroldego (TER) and Touriga Nacional (TNA).

The physicochemical variables analyzed were: density (DEN), alcohol (ALC), titratable acidity (TAC), volatile acidity (VAC), pH (pH), dry extract (DEX), anthocyanins (ANT), total phenolic compounds (TPH), absorbancies at 420 nm (A420), 520 nm (A520) and 620 nm (A620), color intensity (CIN), hue (HUE) and potassium (K). The methodology used in these analyses were based on the work of Ribéreau-Gayon *et al.* (1976).

The sensory evaluation of the 171 wines was performed according to international procedures (Peynaud, 1980; Amerine and Roessler, 1983; SSHA, 1998; Meilgaard *et al.*, 1999; Miele and Miolo, 2003). The sensory analysis sessions were performed in August 2006 by 75 panelists with long enology background. Wine samples were blindly analyzed using ISO glasses, served monadicaly at the temperature of 17°C. The evaluation sheet used was the one from the Organisation Internationale de la Vigne et du Vin and the Association Internationale des Œnologues. The wine quality was rated in a scale ranging from 0 to 100, being 100 the best quality wine.

The wine physicochemical analyses were submitted to the principal component analysis (PCA) (Hair *et al.*, 1995), where geographical origin and varietal wine effects were discriminated.

RESULTS AND DISCUSSION

Results

The PCA showed that there was an important discrimination among the 171 wines as a function of the geographical origin and the varietal wines.

Geographical origin

The discrimination among the geographical origin is shown in Figures 1, 2, 3 and 4. In fact, the three main factors represented 80.65% of the total variation, where factor 1 represented 40.65%; factor 2, 27.54%; and factor 3, 12.46%.

The variables best correlated with the factor 1 were (correlation coefficients between parenthesis): color intensity (CIN) (r= 0.9913), A520 (520) (r= 0.9797), A420 (420) (r= 0.9753), A620 (620) (r= 0.8212), total phenolic compounds (TPH) (r= 0.7733), dry extract (DEX) (r= 0.6710) and anthocyanins (ANT) (r= 0.6664); with the factor 2, potassium (K) (r= -0.8476), pH (pH) (r= -0.8350), density (DEN) (r= -0.8118) and volatile acidity (VAC) (r= -0.7881); and with the factor 3, titratable acidity (TAC) (r= -0.6957) and hue (HUE) (r= 0.6779).

Regarding the viticultural regions, factor 1 discriminated São Joaquim (SJ) and Toledo (T); factor 2, Vale do São Francisco (SF) and Serra do Nordeste B (SNB); and factor 3, Planalto Superior B (PSB). Campanha B (CB) and Serra do Nordeste A (SNA) were intermediary positioned.

Figures 1 and 2 show that wines made in the Vale do São Francisco (SF) viticultural region had higher values of potassium (K), pH (pH), density (DEN) and volatile acidity (VAC). Wines from São Joaquim (SJ) were characterized by higher values of A420 (420), A520 (520), color intensity (CIN), A620 (620), total phenolic compounds (TPH), anthocyanins (ANT) and dry extract (DEX) while those from Toledo (T), lower values of these variables. Figures 3 and 4 show that wines from Serra do Nordeste A (SNA) were characterized by important values of titratable acidity (TAC) and those from the Planalto Superior B (PSB) by hue (HUE).

When the variable quality was included, expressed by the general score, the PCA showed that wines from São Joaquim (SJ) had the highest scores while those from Toledo (T) the lowest ones. This was due to the variables alcohol (ALC) (r= 0.81), A620 (620) (r= 0.77) and dry extract (DEX) (r= 0.77).

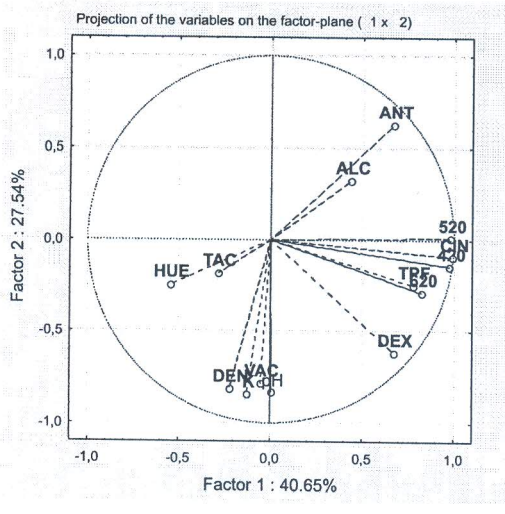


FIGURE 1. Projection of variables on the plane formed by the factors 1 x 2. Legend: TAC = Titratable acidity; VAC = Volatile acidity; ALC = Alcohol; pH = pH; DEN = Density; DEX = Dry extract; ANT = Anthocyanins; TPH = Total phenol compounds; 420 = Absorbancy at 420 nm; 520 = Absorbancy at 520 nm; 620 = Absorbancy at 620 nm; CIN = Color intensity; HUE = Hue; K = Potassium.

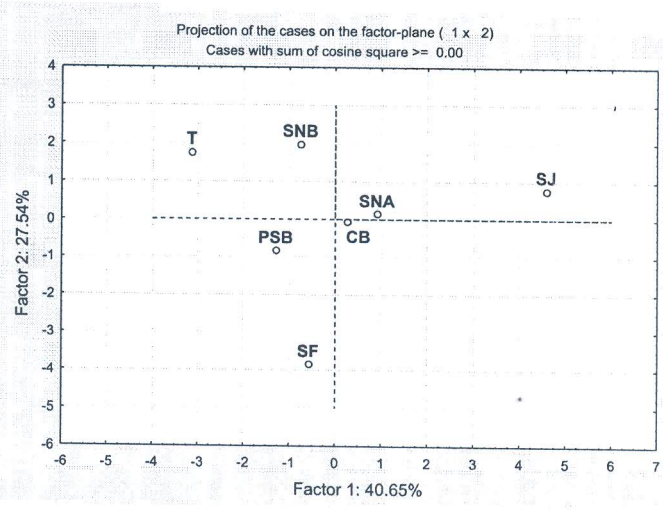


FIGURE 2. Projection of the viticultural regions on the plane formed by the facors 1 x 2. Legend: SJ = São Joaquim; T = Toledo; SF = Vale do São Francisco; SNA = Serra do Nordeste A; SNB = Serra do Nordeste B; PSB = Planalto Superior B; CB = Campanha B.

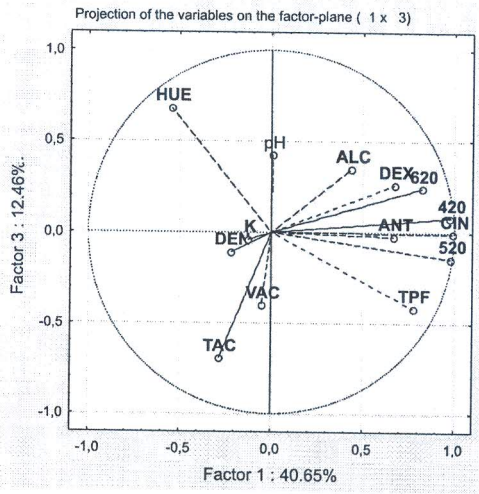


FIGURE 3. Projection of the variables on the plane formed by the factors 1 x 3. Legend: TAC = Titratable acidity; VAC = Volatile acidity; ALC = Alcohol; pH = pH; DEN = Density; DEX = Dry extract; ANT = Anthocyanins; TPH = Total phenolic compounds; 420 = Absorbancy at 420 nm; 520 = Absorbancy at 520 nm; 620 = Absorbancy at 620 nm; CIN = Color intensity; HUE = Hue; K = Potassium.

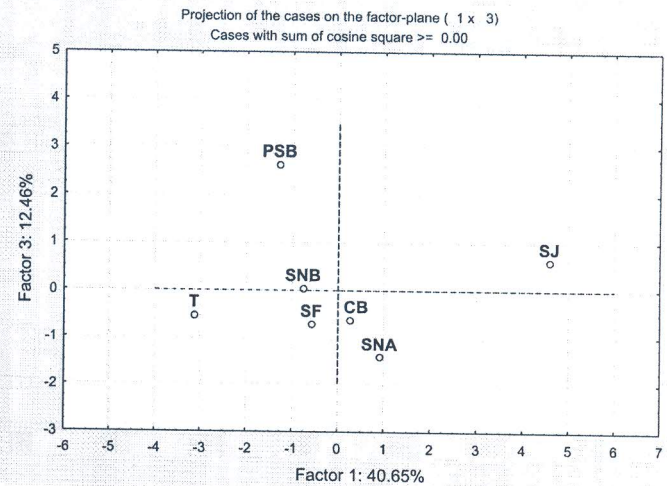


FIGURE 4. Projection of the viticultural regions on the plane formed by the facors 1 x 3. Legend: SJ = São Joaquim; T = Toledo; SF = Vale do São Francisco; SNA = Serra do Nordeste A; SNB = Serra do Nordeste B; PSB = Planalto Superior B; CB = Campanha B.

Varietal wine

The discrimination among varietal wines is shown in Figures 5, 6, 7 and 8. In fact, the three more important factors represented 74.31% of the total variation, where factor 1 was responsible for 39.99%; factor 2, by 19.46%; and factor 3, by 14.86%.

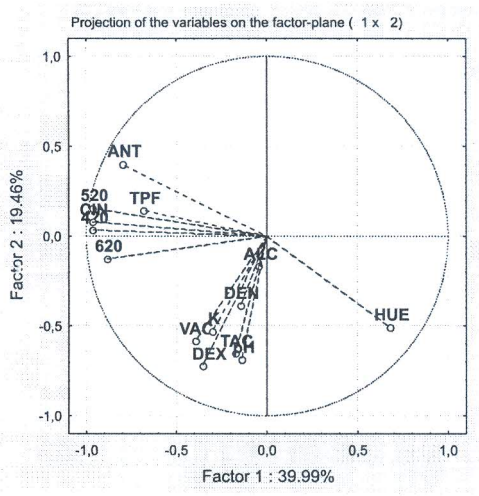
The variables best correlated with the factor 1 were: color intensity (CIN) (r= -0.9688), A520 (520) (r= -0.9666), A420 (420) (r= -0.9641), A620 (620) (r= -0.8868), anthocyanins (ANT) (r= -0.7985), total phenolic compounds (TPH) (r= -0.6819) and hue (HUE) (r= 0.6803); with the factor 2, dry extract (DEX) (r= -0.7219), pH (pH) (r= -0.6819) and titratable acidity (TAC) (r= -0.6563); and with factor 3, alcohol (ALC) (r= -0.9118) and density (DEN) (r= 0.8767).

Regarding the varietal wines, factor 1 discriminated those made from the varieties Ancellotta (ANC), Teroldego (TER), Egiodola (EGI), Refosco (REF), Marselan (MAR), Cabernet Sauvignon (CSA), Pinotage (PTE) and Pinot Noir (PNO); factor 2, from Malbec (MAL) and Arinarnoa (ARI); and factor 3, from Barbera (BAR) and Alfrocheiro (ALF).

The varietal wines Ancellotta (ANC), Teroldego (TER) and Marselan (MAR) had higher parameters of the variables responsible for the wine color and structure, as A520 (520), A420 (420), color intensity (CIN), A620 (620), anthocyanins (ANT) and total phenolic compounds (TPH), while those made from Egiodola (EGI), Refosco (REF), Pinot Noir (PNO) and Pinotage (PTE) had less color and structure. Alfrocheiro (ALF) wine had higher alcohol (ALC) content and Barbera (BAR) higher density (DEN), it means, less alcohol (Figures 5, 6, 7 and 8).

When a wine quality variable was added to the PCA, the varietal wine Teroldego (TER) had the highest score, followed by Arinarnoa (ARI) and Tannat (TAN). Wines made with Barbera (BAR), Refosco (REF) and Pinotage (PTE) presented the lower scores. This was

specially due to the total phenolic compounds present in these wines, responsible for the wine color and structure.



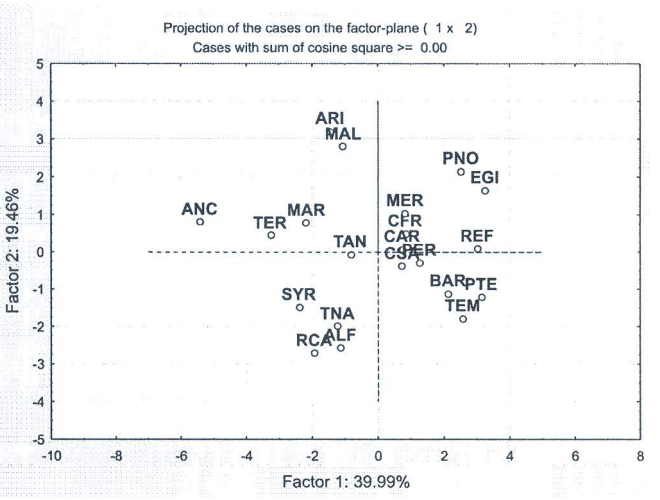
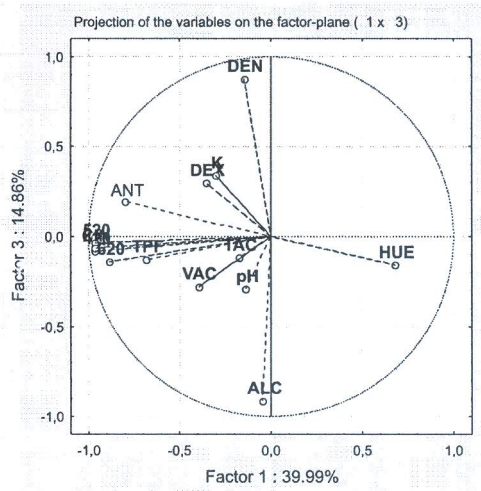


FIGURE 5. Projection of variables on the plane formed by the factors 1 x 2. Legend: TAC = Titratable acidity; VAC = Volatile acidity; ALC = Alcohol; pH = pH; DEN = Density; DEX = Dry extract; ANT = Anthocyanins; TPH = Total phenol compounds; 420 = Absorbancy at 420 nm; 520 = Absorbancy at 520 nm 620 = Absorbancy at 620 nm; CIN = Color intensity HUE = Hue; K = Potassium.

FIGURE 6. Projection of the varietal wines on the plane formed by the factors 1 x 2. Legend: ALF = Alfrocheiro; ANC = Ancellotta; ARI = Arinarnoa; BAR = Barbera; CFR = Cabernet Franc; CSA = Cabernet Sauvignon; CAR = Carmenère; EGI = Egiodola; MAL = Malbec; MAR = Marselan; MER = Merlot; PER = Periquita; PNO = Pinot Noir; PTE = Pinotage; REF = Refosco; RCA = Ruby Cabernet; SYR = Syrah; TAN = Tannat; TEM = Tempranillo; TER = Teroldego; TNA = Touriga Nacional.



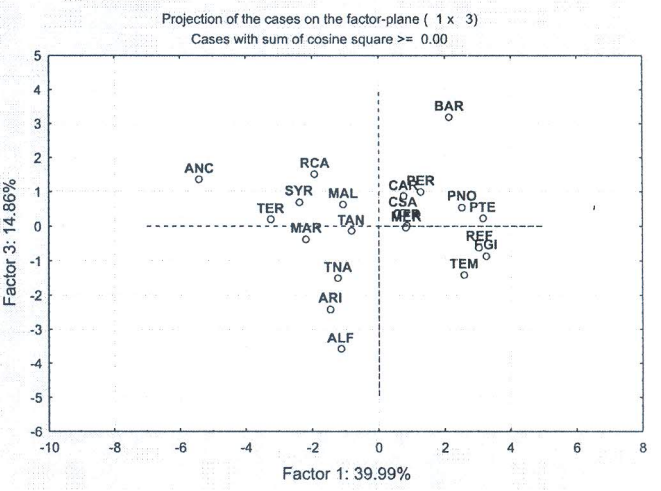


FIGURE 7. Projection of the variables on the plane formed by the factors 1 x 3. Legend: TAC = Titratable acidity; VAC = Volatile acidity; ALC = Alcohol; pH = pH; DEN = Density; DEX = Dry extract; ANT = Anthocyanins; TPH = Total phenolic compounds; 420 = Absorbancy at 420 nm; 520 = Absorbancy at 520 nm; 620 = Absorbancy at 620 nm; CIN = Color intensity; HUE = Hue; K = Potassium.

FIGURE 8. Projection of the varietal wines on the plane formed by the factors 1 x 3. Legend: ALF = Alfrocheiro; ANC = Ancellotta; ARI = Arinarnoa; BAR = Barbera; CFR = Cabernet Franc; CSA = Cabernet Sauvignon; CAR = Carmenère; EGI = Egiodola; MAL = Malbec; MAR = Marselan; MER = Merlot; PER = Periquita; PNO = Pinot Noir; PTE = Pinotage; REF = Refosco; RCA = Ruby Cabernet; SYR = Syrah; TAN = Tannat; TEM = Tempranillo; TER = Teroldego; TNA = Touriga Nacional.

Discussion

Wines made in São Joaquim, a somewhat colder and higher viticultural region – average of 1,200 m high –, had higher values of variables related to the wine color and structure. On the other hand, wines from Toledo, state of Paraná, and Vale do São Francisco, states of Pernambuco and Bahia, a semi-arid region presenting high temperatures, had the lowest values. This is a general trend in most regions of the world. There are researchers showing that the amplitude between night and day temperatures is responsible for a more intense synthesis of anthocyanins. However, other authors concluded that low temperature are sufficient for this synthesis. It is important to mention that the concentration of anthocyanins in the red grape skin and wines is not only a function of the environment. Indeed, it depends on other factors, such as the cultural practices used in a vineyard – as the canopy and soil management – and during winemaking.

In the present work, wines from São Joaquim had the highest scores. However, it is important to mention that the number of samples of this region was small compared with those from the Serra Gaúcha. Nevertheless, the results show that this region has climatic conditions to produce wines with intense color and structure. On the other hand, wines produced in regions presenting high temperatures, such as Toledo in the state of Paraná, have opposite characteristics.

Regarding the varietal wines, results show that Ancellotta, Teroldego and Marselan had more intense color and were more structured, while those of Egiodola, Refosco, Pinot Noir and Pinotage presented lower values. This was due to the genetic characteristics of these varieties and to the local soil and climatic conditions where they were cultivated. In respect to the alcohol content and density, it is difficult to comment these variables because there is no information about must chaptalization.

CONCLUSION

The principal component analysis discriminated wines from the 2006 vintage made in five – of a total of seven – Brazilian viticultural regions. Variables used in this study were specially related to the total phenolic compounds, such as anthocyanins, but others, such as alcohol, were considered too. The five regions discriminated were São Joaquim, Toledo, Vale do São Francisco, Serra do Nordeste B e Planalto Superior B.

In the same way, the following varietal wines were discriminated: Ancellotta, Teroldego, Egiodola, Refosco, Marselan, Cabernet Sauvignon, Pinotage, Pinot Noir, Malbec, Arinarnoa, Barbera and Alfrocheiro.

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