CHARACTERIZATION OF AROMATIC PROFILES IN BRAZILIAN TROPICAL WINES DETERMINED BY GAS CHROMATOGRAPHY AND MULTIVARIATE STATISTICAL ANALYSIS

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Summary

Tropical wines have been produced in Thailand, India, Venezuela and mainly in Northeastern Brazil. In Brazil, this activity started twenty-five years ago and has been studied only in the last years. In this Brazilian Area, between 8-9° parallel of the South Hemisphere, it is possible to have two or three harvests per year due to the high temperatures (annual average temperature of 26 °C), high luminosity and use of irrigation. Analytical composition of grapes and wines can vary strongly according to harvest date into a year, (wines elaborated in the first or second semester). The aim of this work was to determine metabolic fingerprints of white and red wines from two vintages of 2009, according to their aromatic profile, using gas chromatography and multivariate statistical analyses. Wines were elaborated by traditional methods, in stainless steel tanks of 200 L, by controlling fermentations temperature for red and white wines and using antioxidants. After stabilization and bottling, wines were analyzed in triplicate using gas chromatography with flame ionization detector (GC-FID). PCA multivariate statistical analysis was applied on aromatic compounds data to discriminate between wine type and month of winemaking, and different clustering were formed. White and red tropical wines presented different aromatic compound concentrations; higher alcohols were more efficient to separate wine samples than volatile esters.

INTRODUCTION

The Sub-middle region of the São Francisco river Valley presents a semiarid tropical climate with characteristics allowing to scale grape harvests for winemaking throughout the year (Tonietto and Teixeira, 2004). Grapes and wines elaborated in different months present variations in composition, quality and typicality (Pereira *et al.*, 2008).

The aromatic composition of fermented beverages is complex. Biochemical reactions involving the biological process of aroma compounds formation can be influenced by climate conditions and its determination allows to understand and to describe wines characteristics (Usseglio-Tomasset, 1995). The wine aroma is composed by a large number of volatile constituents (more than 500 already identified), with concentrations ranging from few nanograms to some milligrams per liter (Bayonove *et al.*, 2000).

Brazilian tropical wines have been studied only in the last years and researches are being developed to characterize the effect of climate and soil conditions on the adaptation of different cultivars, by determination of grape and wine composition (Pereira *et al.*, 2007a, b, c; 2008). The aim of this work was to determine aromatic composition of tropical red and white wines from Northeast of Brazil, using gas chromatography with flame ionization detector (GC-FID) and multivariate statistical analyses, to find aromatic markers and to explain the wine variability.

MATERIAL AND METHODS

Grape harvests were carried out in June (Harvest I) and November (Harvest II) of 2009, for white cultivars Chenin blanc (CB), Sauvignon blanc (SB) and Verdejo (VE), and reds Cabernet Sauvignon (CS), Petit Verdot (PV) and Grenache (GR). The winemaking process adopted was the traditional one with control of fermentation temperatures for red (25 °C and 18 °C for alcoholic and malolactic fermentations, respectively) and white (18 °C for alcoholic fermentation only) (Peynaud, 1997; Boulton *et al.*, 1996). Wines were analyzed in triplicate by gas chromatography with flame ionization detector (GC-FID) and quantified using internal standardization (Bertrand, 1981). Seven higher alcohols and ethyl acetate were quantified by direct injection of the wine distillates with addition of 4-methyl-2-pentanol as internal standard. Multivariate statistical analysis was applied (principal component analysis – PCA) to discriminate groups and to explain the wine variability.

RESULTS AND DISCUSSION

PCA applied on GC-FID data of higher alcohols from six white wines analyzed in triplicate showed a good separation (Figure 1). PC1 x PC2 explained 86.3% of total variability. Wines elaborated from three grape cultivars in

two different periods in the same year presented variability in aroma compounds that can be explained by climate conditions (Peynaud, 1997; Usseglio-Tomasset, 1995). For white wines, Chenin blanc (CB) elaborated in June (Harvest I) presented higher concentration of 2-metil-1-propanol, located in the negative side of PC2, while the ones elaborated in November (Harvest II) presented ethyl acetate as marker. Sauvignon blanc (SB) from June (Harvest I) presented 2-metil-1-butanol as main higher alcohol, in the positive side of PC1, while Sauvignon blanc from November (Harvest II) presented, as Chenin blanc, ethyl acetate as aromatic marker. Verdejo (VE) elaborated in June presented ethyl acetate and 2-metil-1-propanol as markers. Volatile esters didn't present a good separation (data not shown).

For red wines, the results were different as compared to the white ones (Figure 2). PC1 x PC2 explained 87.93% of total variability. Cabernet Sauvignon (CS) wines elaborated in June and November presented similarities, the climate conditions didn't change the aromatic profile. The compounds responsible were identified as 3-metil-1-butanol and ethyl acetate. Petit Verdot (PV) also presented little differences, being wines from November (Harvest II) characterized by higher concentrations of ethanal than Petit Verdot from June (Harvest I). This fact can be explained by higher temperatures in the second semester and collaborated to increase the oxidation of the wines (Peynaud, 1997). Only wines from Grenache (GR) presented big differences according to the month of winemaking. Grenache from June (Harvest I) presented 3-metil-1-butanol as aromatic marker, in the negative side of PC2, while Grenache from November (Harvest II) presented 2-metil-1-butanol in higher concentrations. Red wines had different responses as compared to white wines, that were more influenced by climate conditions.

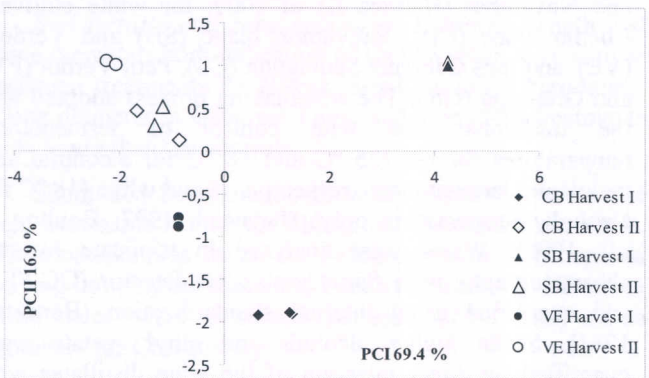

Figure 1. PCA obtained from 18 white wine samples analyzed by GC-FID in two harvest dates, in June (Harvest I) and November (Harvest II) of 2009, for the determination of the higher alcohols. PC1 x PC2 explained 86,3% of the total variability. CB: Chenin blanc; SB: Sauvignon blanc; VE: Verdejo.

Chenin blanc and Cabernet Sauvignon wines showed higher concentrations of higher alcohols, among all wines analyzed in this work, associated to 1-propanol and 3-methyl-1butanol, respectively, that contribute to the aromatic complexity of these wines.

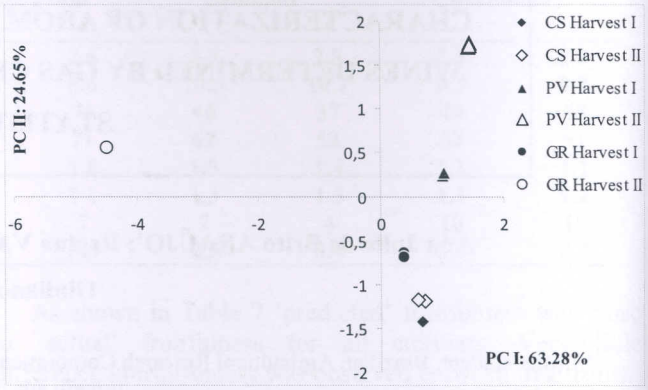

Figure 2. PCA obtained from 18 red wine samples analyzed by GC-FID in two harvest dates, in June (Harvest I) and November (Harvest II) of 2009, for the determination of the higher alcohols. PC1 x PC2 explained 87,93% of the total variability.CS: Cabernet Sauvignon; PV: Petit Verdot; GR: Grenache.

CONCLUSIONS

The differences found between concentrations of volatile compounds among the wines evaluated may be explained by peculiarities of the influence of gene expression for each grape variety and the climate conditions of Northeast Brazil. For white wines the two different months were more important to change wine composition then for red wines. Higher alcohols were more discriminating factors then volatile esters.

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