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Physical and chemical parameters of Sauvignon Blanc dry white wines from different areas in Romania

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Abstract
Wine holds an important part in the alimentary sector of the global economy that can be partly explained by its beneficial effects on human health. Its various chemical compounds, like the polyphenols and the flavonoids, not only contribute to exceptional sensorial properties, but also offer antioxidant, anti-inflammatory and anticarcinogenic protection. Wines' chemical composition can be described in terms of physicochemical parameters.
The aim of the present study was to evaluate physical and chemical parameters for the Sauvignon Blanc dry white wine originating from vineyards in different regions in Romania (Banat, Transylvania, Muntenia, Moldavia and Dobruja). Our analysis showed significant variations of some physical parameters, such as pH, viscosity, Brix degree and electrical conductivity. Spectrophotometry was used in order to evaluate color intensity and shade at 420 nm, 520 nm and 620 nm, with 420 nm as the predominant wavelength. Our results show significant differences. Samples originating from Banat (Mocrea) and Transsylvania (Jidvei) had a higher viscosity, while the electrical conductivity showed larger values in the Transylvania (Jidvei) and Dobruja (Alira) samples.

Keywords: dry white wine, viscosity, pH, Brix degree, spectrophotometry

Introduction

As early as from Antiquity, wine was considered to have a favorable impact on health. Hippocrates prescribed it for wounds 'treatment, in fevers, as purgative and diuretic or to increase nutritional value in different diets. Its medical usages across different historical periods are confirmed by recent medical research. The chemical compounds in grapes, grape must and wine have antioxidant, anti-inflammatory, anticarcinogenic, antimicrobial, antiviral, cardio-, neuro- and hepatoprotective effects. Several studies confirm that a moderate intake of wine has a beneficial impact on health [9, 14, 21].

Currently, wine industry plays an important role in the global economy, as wine production and consumption represents a significant percentage of the alimentary sector [17]. Wine is constantly present in the diet in many countries, given its nutritional properties [1, 5, 20].

When establishing wine quality it is important to assess its chemical properties, as it is rich in various chemical compounds, like polyphenols and minerals [3]. The polyphenols have a high impact on the oenological quality. They have a direct influence on the sensorial properties, as the color, the astringency and the bitterness. The flavonoids are responsible of the white wines' color, while the red ones' is influenced by the anthocyanins [2, 6, 13, 19].

The qualitative features of the wine, such as the alcohol content, the residual sugar, the dry extract, along with others are influenced by its chemical composition, which depends mainly on: grape variety, factors connected to the location of the wine cellar (altitude, soil, sun exposure, geological features), the climate, the grapes' maturity degree, viticultural practices, winemaking conditions [13]. Wines obtained from the same grapes' variety can show differences in chemical composition and sensorial features determined by the above mentioned factors.

The wine is composed of water (approximately 84%), ethanol (approximately 15%) and other compounds. The most frequent practice used in the description of a wine is the sensorial analysis offered by

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wine tasting. However, new, objective methods should be considered, such as the description of the physical parameters. Previous studies have found that mouth sensation, alcohol content and other wine properties can be correlated with viscosity measurements [4, 11, 18, 22]. The viscosity is a property that can be easily measured with a viscometer and by determining the factors that affect viscosity, wine can be optimized. The sensorial analysis seems to be influenced by glycerol, ethanol and sugar content, although there is no research to fully describe their contribution.

Sauvignon Blanc is one of the main white varieties in the world regarding cultivated surface and wine volume, adapted for various climate and soil conditions. There are over 5000 ha cultivated with this variety in Romania, a country occupying the 7th place in the world regarding grapes and wine production.

The aim of the present study was to investigate certain physicochemical parameters, such as viscosity, density, electrical conductivity, pH, Brix degree and color parameters for Sauvignon Blanc dry white wine, originating from different vineyards in Romania.

Material and Method

White Wine Samples

We analyzed 8 Sauvignon Blanc dry white wine samples, originating from different vineyards and different regions in Romania. The wine bottles were bought from local shops and kept at room temperature. We measured the viscosity, density, pH, electrical conductivity and Brix degree for each wine bottle, respectively wine sample, in maximum 4 to 5 hours after opening.

The vineyards of origin were situated in different regions: Banat, Transylvania, Oltenia, Muntenia, Moldavia and Dobrogea as showed in Table 1.

Table 1. List of Sauvignon Blanc dry white wines samples analyzed in the present study

Sample no	vineyards	Geographical Region	EtOH Vol (%)
S1	Recas	Banat	12.5
S2	Silagiu	Banat	13.9
S3	Mocrea	Banat	14.2
S4	Jidvei	Transilvania	13
S5	Sâmburesti	Oltenia	13
S6	Ceptura	Muntenia	13
S7	Panciu	Moldova	13.9
S8	Alira	Dobrogea	13

Determination of physical and chemical parameters

The physical and chemical parameters were determined according to the International Organization of Vine and Wine (OIV) standardized methods described in the Technical Regulation “Analysis methods in wine production” (HG RM no.708 from 20.09.2011). The research was carried out in the Biophysics Laboratories within the Victor Babes University of Medicine and Pharmacy in Timisoara.

The viscosity is defined as the fluids property to oppose resistance to flow, as result of the mechanical interaction between its constituent particles. The relative viscosity was determined with the Ubbelohde viscometer [10].

The amount of dissolved solids was measured in Brix degrees, using a portable refractometer (VWR), allowing measurements within a 0-54% range.

The density was determined with the pycnometer standardized method.

pH measurements were carried out using the analytical methods recommended by the International Organization of Vine and Wine (OIV) [12]. The pH and the electrical conductivity were determined with a CONSORT 3010 multiparameter analyzer. Conductance measurements were preceded by calibration and distilled water conductance was below 50 µS [10].

A wine’s color is completely defined by lightness, cromatics (defined by the dominant wavelength dominant) and purity. The color’s intensity is given by convention by the following expression: $I = A_{420} + A_{520} + A_{620}$, considering 3 decimals. The color N is given by convention by the following expression: $N = A_{420}/A_{520}$, where A_{420}, A_{520} and A_{620} are wine’s absorbance measured by spectrophotometry at 420, 520 and 620 nm with a VIS Metertech spectrophotometer [10].

To account for repeatability, all measurements were performed three times and the values were introduced in an Excel database. Mean values with standard deviations were computed. In order to test the difference between the mean values of the studied variables, one-way Anova test was used. Pearson

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correlation coefficient was computed to analyze the linear correlation between the different measured variables. Significance was considered for $p<0.05$.

Results and Discussion

Sauvignon Blanc is a fresh and revigorating wine with subtle flavors of white acacia flowers and fine notes of lemon peel. Its taste is crisp and citrous, with a special liveliness. The soft notes of green apple and elderflowers, typical for this variety, will long remain in the taster's memory.

These special properties are highly influenced by the wine's composition, which can be evaluated by physical and chemical parameters. Table 2 comprises the results of the measurements performed in our study.

Table 2. **Physical and chemical parameters of Sauvignon Blanc dry white wines varieties (mean value± standard deviation)**

Sample no	Areas	pH	Brix degree	Viscosity (mPa·s)	Relative density at 20˚C	Electrical conductivity (mS)/cm)	Wine color (A420nm)	$I=A_{420}+A_{520}+A_{620}$	ColorI (N)
S1	Banat (Recas)	3.24	6.7	1.5272±0.022	0.9929	1.36±0.058	0.135	0.156	7.105
S2	Banat (Silagiu)	3.07	7.8	1.5916±0.013	0.9904	1.44±0.017	0.121	0.14	8.066
S3	Banat (Mocrea)	3.25	7.7	1.6359±0.016	0.9899	1.24±0.041	0.071	0.08	7.888
S4	Transylvania (Jidvei)	3.27	8.1	1.6317±0.017	0.9909	1.51±0.005	0.067	0.081	6.090
S5	Oltenia (Sâmburesti)	3.14	7.5	1.5789±0.006	0.9927	1.44±0.08	0.055	0.064	6.111
S6	Muntenia (Ceptura)	3.15	6.8	1.5874±0.0133	0.9923	1.43±0.09	0.101	0.114	7.769
S7	Moldavia (Panciu)	3.13	7	1.6128±0.017	0.9469	1.17±0.04	0.110	0.134	5.238
S8	Dobrogea (Alira)	3.29	7.9	1.6128±0.004	0.9918	1.69±0.01	0.061	0.070	6.777

The pH is a fundamental parameter in wine industry. Its value highly influences wine's properties, such as the color, the oxidation or the biological and chemical stability. In our samples, the pH varied between 3.07 and 3.29. The lowest value was measured in the wine originating from the Silagiu vineyards (Banat) and the highest in the one from Alira vineyards (Dobrogea), reaching 3.29.

Tables 3 and 4 contain the values of the Pearson coefficients for the correlations between viscosity, Brix degrees, pH and Alcohol content.

Table 3. Pearson correlation coefficient matrix between values of viscosity, Brix degree, and alcohol content measurements for all wine samples.

	EtOH(%)	*Brix degree*	*Viscosity*	*pH*
EtOH(%)	1			
Brix degree	0.27411	1		
Viscosity	0.614053	0.674474	1	
pH	-0.36125	0.278985	0.214506	1

Table 4. Pearson correlation coefficient matrix between values of viscosity, Brix degree, and alcohol content measurements for Banat's wine samples.

	EtOH (%)	*Brix degree*	*Viscosity*
EtOH (%)	1		
Brix degree	0.969315	1	
Viscosity	0.968623	0.877806	1

Regarding the alcohol content, the viscosity and the Brix degree, we found a stronger correlation for the wines originating from the Banat region, compared to the values obtained for the total of 8 samples that ranged

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up to 0.67447. The similar values for most of the samples can be justified by the common processes used in the production of the commercial wine. The strong correlation is explained by the connection between the viscosity and the sugar content, respectively the chemical composition of the wine.

A previous study has found a viscosity of approximately 1.40 mPa·s for a commercial wine with a 12% alcohol content at 25ºC [16]. For the dry Sauvignon Blanc there were reported a mean dynamic viscosity of 1.225 mPa·s at 25ºC and 6.95 Brix degrees for a 13.75% alcohol content [7]. Temperature is a physical parameter that influences viscosity in an inversely proportional relationship. Our measurements were performed at 20ºC and wine's viscosity ranged between 1.5272 mPa·s for the sample originating form Recas vineyards and 1.6359 mPa·s for the one from Mocrea vineyards, situated also in the Banat region. Concerning viscosity, there are significant differences between the samples originating from different geographical regions ($p<0.05$), as well as between samples originating from different cellars in the same region, like the Banat one ($p=0.0008$).

The fact that we found a strong correlation between the viscosity and the ethanol content (0.614), while the one with the pH was weak (0.214), indicates the fact that the ethanol could be an important element in the composition to increase the dynamic viscosity of the dry commercial wine.

Regarding the electrical conductivity, the highest value was obtained for the sample S8, from Alira cellar, in the Dobruja region (1.69 mS/cm) and the lowest value, of 1.17 mS/cm, in the sample from Panciu cellar, in the Moldavia region. The electrical conductance is an indicator of the salt content in the wine. There are significant differences between the wine samples originating from different geographical regions ($p<0.05$), but also between wine samples originating from the same region, like Banat ($p=0.004$).

The relative density is directly influenced by the amount of sugars in the wine. The density of the alcohol is lower than the one of the water, resulting in a specific weight of approximately 0.8 or 20% lower. As the sugar in the must is consumed and converted into alcohol, the density decreases. When the fermentation is complete, the specific weight of the wine should be approximately or a little lower than 1 [16]. The highest density was found in the wine originating from the Recas vineyards (Banat), while the lowest, in the sample form the Moldavia region (Panciu).

Each cellar can use different winemaking processes in the production of the commercial wines. However, in important feature of the Sauvignon Blanc is represented by its pale yellow coloration, its intense aromatic concentration and the high acidity [8, 15].

The color is one of the most important available visual features, offering a considerable amount of relevant information. Wine color is defined completely by the lightness, the chromatic and the purity. The chromatic is represented by the dominant wavelength (which characterizes the color) and by the purity of the color. The dominant wavelength in the description of wine's chromatic is 420 nm.

Figure 1 shows the variation of the absorbance at 420 nm wavelength (A420 nm) for the samples in our study.

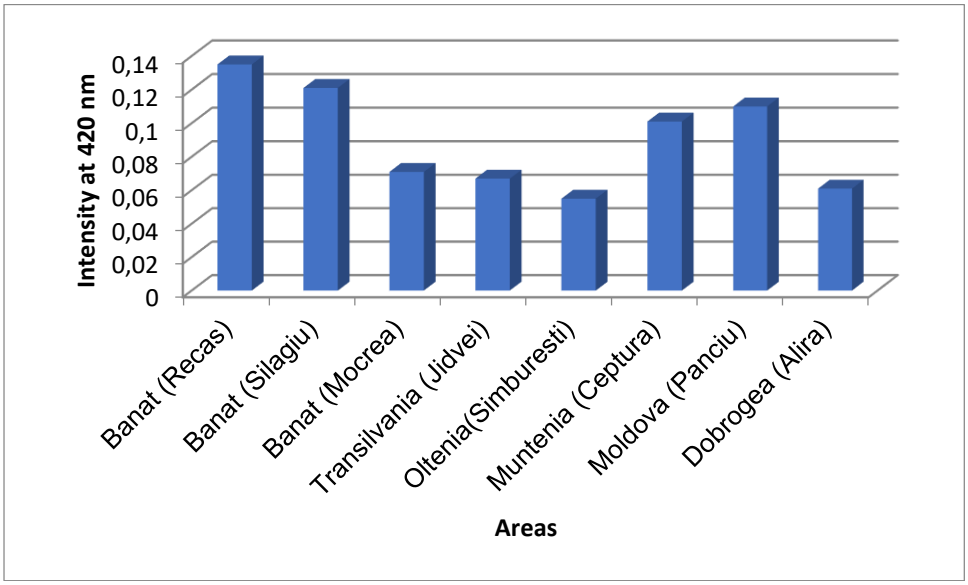

Figure 1. Variation of the absorbance (A) at 420 nm

The highest intensity (0.156) was obtained for the sample originating from the Recas vineyards (Banat) and the lowest in the one from Sâmburesti vineyards (Oltenia).

Conclusions

The results of our study have found differences in the chemical composition of the wines originating from different geographical regions, shown by the variations of the physical parameters that we investigated. These parameters can be used in the evaluation of the wine quality (especially the viscosity). Our study indicates differences in the dynamic viscosities measured for the commercial wines. The Sauvignon Blanc originating from Banat (Mocrea) and Transylvania (Jidvei) showed higher viscosity and pH. We also found positive correlations with chemical parameters, such as the pH. There are only a few studies in the literature to investigate the association between the pH and the viscosities of wines, which could become a future direction of investigation.

It is not fully explained the manner in which the composition of the dry white wine influences their dynamic viscosity. The range of wines we investigated is not large. Therefore, the present study should be completed by a future research, investigating a larger variety of commercial wines.

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