COMPARISON OF COLOR PARAMETERS OF RED WINES PRODUCED FROM ALBANIAN AUTOCHTHONOUS GRAPE VARIETIES USING TRICROMATIC METHOD

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Abstract.

The color represents an important parameter of wine quality. This characterizes sort, type, composition and age of wine. Unlike white wines, the red wine color is determined by the presence of some specific substances – anthocyanic pigments. A big importance on the color of red wine presents tenant substances, acidity, metals, reductive substances. The color of wine is affected by several factors, among the more important being grape variety, pH, temperature, oenological treatments and aging. Research has been made on four red wines from Albanian native grape varieties (Serin i zi, Debin e zeze, Shesh i zi, Kallmet) and two red wines from international grape varieties Merlot and Cabernet Sauvignon, grown in Albania. Chromatic characteristics of wines were determined by Spectrophotometric method. For this purpose, the following indicators were measured: the intensity of color, color tint of wine, the percentage of red, yellow and blue color and defined variables X, Y, Z, using the CIE system (Commission Internationale de l'ECLAIRAGE).

Keywords: Red wine, color, ageing in bottle, C.I.E. variables.

1. Introduction

Color is one of the main organoleptic characteristics used to establish the quality and acceptability of wine. The use of sensory panels to measure color is complex, time-consuming, expensive and subject to error owing to variability in human judgment. It would thus be useful to have an objective system for the measurement of the spectral characteristics and color coordinates of samples.

The objective appreciation of color is using photo-colorimetric methods or spectrophoto-colorimetric, expressing being made through absorption of some radiation on the visible spectrum. In the same way the most precise method of color expression in wine is the method that gives back the absorption for all colors which form the characteristic color of the food product. The red color of wines is mainly due to both anthocyanins and polymeric pigments and depends on several factor, including the age of the wine, but the measurement of the age of a wine is an unresolved problem [1, 3]. At international level were made researches that certify the fact that exist a strong correlation between the origin place (vineyard), grape's variety and chromatic properties of red wines produced from these varieties [5,6, 7, 8].

For simple and global characterization of red wine color, on the bases of optic densities at bandwidth characteristics, we foresaw a series of indexes, out of which we recall: color intensity, tint and the weight of every color. Red wine color determination can be evaluated by adding the three components: red, yellow and blue. The red component (absorbance to 520 nm) is ascribed to free anthocyans under the form of flavilium cations and combinations of anthocyans-tannins in older wines. The yellow component (absorbance to 420 nm) is ascribed to tannins and anthocyans degradation products. The blue component (absorbance to 620 nm) is ascribed to free anthocyans under the chinonic form or combinations between tannins and anthocyanins.

The C.I.E. system of color is a more objective means of specifying color in accordance with the recommendations of the International Commission on Illumination in terms of a tristimulus system, a defined standard observer and a particular coordinate system. In the C.I.E. system, color is specified in terms of the three primary values: amber – X, green – Y, and blue – Z. These values can be obtained with spectrophotometers. From the tristimulus values, the proportions of each primary are calculated as the following ratios:

$$x = \frac{X}{X+Y+Z} \qquad y = \frac{Y}{X+Y+Z}$$

$$z = \frac{Z}{X+Y+Z}$$

These are referred to as the chromaticity coordinates or trichromatic coefficients. Since x + y + z = 1, it is sufficient to use x + y to define chromaticity. The x and y coordinates can be plotted on a chromaticity diagram and the color of the test food can be located in color and space.

A third system, the Hunter color solid attempts to reconcile differences between the Munsell and C.I.E. color spaces. Color parameters are L, ± a, and ± b, where L is visual lightness. Although the wine color plays a major role in the final quality of red wine, which undergoes color changes during ageing in bottles are not fully evaluated [4, 10, 11].

The purpose of this paper is to make a preliminary assessment of our native grape varieties in relation to the potential of creating quality red wines, with regard to color parameter, compared with wines produced by international varieties. For this purpose, were defined the indicators, colorimetric parameters and CIELAB variables to red wines made from local varieties of Serin i zi, Debin e zeze, Shesh i zi, Kallmet, and international Merlot and Cabernet Sauvignon. These indicators were defined to wines produced in 2009 and 2011.

2. Materials and Method

2.1 Red wine samples

For this paper were taken in study red wines produced from Albanian grape varieties Serin i zi, Debin e zezë, Shesh i zi, Kallmet, and international grape varieties Merlot and Cabernet Sauvignon cultivated in Albania. The grapes were harvest at their mature state, brought at the canteen of the Faculty of Biotechnology and Food where was produced red wine using the traditional method of vinification. The fermentation process was controlled daily and fermentation temperature fluctuated from 25-27 ^{0}C. At the end of fermentation, red wines were not filtrated. Before bottling SO_2 level were regulate to 30mg/L, and then were stored in cellar of the Faculty of Biotechnology and Food. New red wines and two years aged red wines were analyzed from the above varieties.

2.2 Color measurements

Color Intensity (CI), Tint (T): CI and T were determined using the spectrophotometric absorbance of the red wines at 420, 520 nm [4], and the following calculations:

$$CI = Abs^{420} + Abs^{520}$$

$$T = Abs^{420}/Abs^{520}$$

The spectral transmittances in the visible spectra (λ = 380 – 780nm) were measured with the spectrophotometer. To obtain the tristimulus values, recommendations made by the Commission Internationale de l'Eclairage: CIE 1931, 1964 (x,y) system (CIEXYZ), CIE 1976 (L*a*b*) space (CIELAB), CIE 1986 and CIE 1995 were appled, using as references the CIE 1995 [2]. Distilled water was used as references blank. Each measurement was performed in treplicate.

3. Results and discussion

The results obtained from analysis for tint and color intensity for our red wines in study are given in histograms 1 and 2.

Low color tint values, not exceeding T=0.6, are characteristic for young red wines [4].

By comparing the results of absorbance values for red wines produced from autochthonous varieties for color tint (T) and color intensity (I), we observe that the color tint increase during aging, while color intensity (CI) decreases. This is in accordance with the rule, which say that the absorbance reading for aged wines at 520 nm decreases while at 420 nm increases, due to the shift from monomeric to polymeric anthocyanins [9].

For Albanian native varieties, Shesh i zi wines from Tirana area has the highest value for color intensity followed by Shesh i zi from Vlora. When compared with international varieties we note that the highest value for color intensity is Merlot wine, while Cabernet Sauvignon wine has nearly identical amount with Shesh i zi wines. From the histograms for 2 years aged wines, the highest value for color intensity has Merlot wine followed by Shesh i zi and Cabernet Sauvignon wine, while Serin i zi wine from Përmeti area has the lowest intensity.

The value of color tint for young wines range from 0,607-0,787 Shesh i zi and Serin i zi respectively. These values are characteristic for young red wines, which increases on levels 0,907-1,386 while the wine ages. The biggest change of tint value is observed for Serin i zi and Kallmet wines. These wines have undergone the greatest transformation of color from bright red for young wines to orange-red for 2 years aged wines. Smaller change for tint is observed for Shesh i zi wine which is on the same level of change with international varieties Cabernet Sauvignon and Merlot. Given these two parameters of color, the most suitable wine variety for ageing is Shesh i zi. In Table 1 is presented the percentage contributions of red, yellow and blue in total color of young and 2 years aged wines.

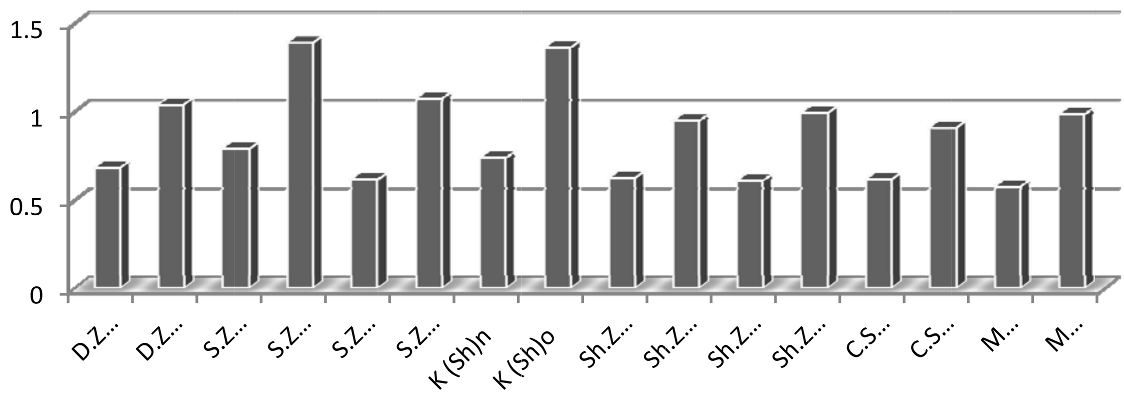

Figure 1: Chart of color tint of young and old red wines.

n = new wines, o = 2 years aged wines. D.Z (Pr) = Debin e Zeze (Permet); S.Z (Pr) = Serin i zi (Permet); K (Sh) = Kallmet (Shkoder); Shr.Z (Vl) = Shesh i zi (Vlore); Sh.Z (Tr) = Shesh i zi (Tirane); C.S (Br) = Cabernet Sauvignon (Berat); M (Br) = Merlot (Berat).

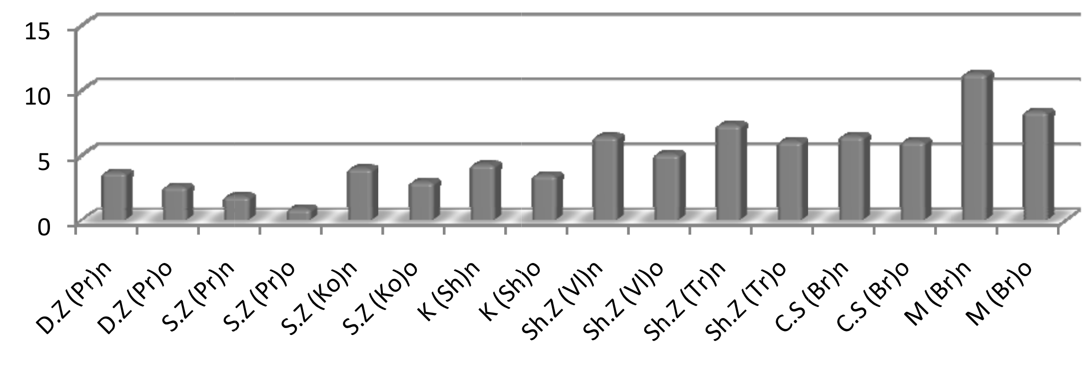

Figure 2: Chart of color intensity of young and old red wines.

n = young wines, o = 2 years aged wines. D.Z (Pr) = Debin e Zeze (Permet); S.Z (Pr) = Serin i zi (Permet); K (Sh) = Kallmet (Shkoder); Shr.Z (Vl) = Shesh i zi (Vlore); Sh.Z (Tr) = Shesh i zi (Tirane); C.S (Br) = Cabernet Sauvignon (Berat); M (Br) = Merlot (Berat).

From the dates shown in table 1, it was observed that the pigments structure reflects exactly the chromatic features of analyzed red wines. In general case, for wine with red shade, the red pigment class participates in more measure (over 40%) to underline the wine color, for wine with orange-red shade, the red pigment percent decrease (< 40%) being accompanied by yellow-orange pigments percent increasing (over 45%). For young wines the percent of red color range from 46% - 53%, while the percentage of yellow from 36%- 41%. These values change during ageing where the red contribution decrease to less than 44% while the yellow percentage increase to more than 43%. Serin i zi has the highest value of red contribution with 52% followed by Shesh i zi with 51%, and the lowest value of yellow contribution has Shesh i zi with 36.42%. For aged red wines the highest value of red contribution has Shesh i zi with 44.49% followed by Debin e zeze with 43.89%. The yellow color proportion exceeds that of the red color in Kallmet, Serin i zi and Debin e zeze wines. These wines have strongly altered chromatic characteristics shifted to the yellow tones of the spectrum while they age. These results reveal that wines from typical

Albanian grape varieties Kallmet, Serin i zi and Debin have less expressed red color in aged wines. Meanwhile Shesh i zi wines stay in the red zone even when they age and with their chromatic characteristic are close to wines from internationally recognized grape varieties Cabernet Sauvignon and Merlot. The class of blue pigments participates at total color of wine in measure of 9% - 18%. The biggest percent of blue pigment was found in Merlot and Cabernet Souvignon wines.

The color parameters determined in table 2 were as follows tristimulus values, X, Y, Z, chromaticity coordinates x, y, z, obtained by standardizing tristimulus values and CIELAB coordinates. Color coordinates L represents the lightness and a* and b* indicate the change in hue from red to green and from yellow to blue, respectively. All parameters showed variability between wine varieties and during ageing. By analyzing the data it seen that there are some significant differences between chromatic characteristics for all wines samples studied. By comparing values of Y and L (both represents lightness) between young and aged red wines we see that both parameters show the same direction of change during ageing. The highest value for lightness (L and Y) has Kallmet followed by Shesh i zi for young wines, while for aged wines is Cabernet

Table 1. The color contribution for young(n) and two years aged(o) red wines.

Young red wines	% Red	% Yellow	% Blue
D.Z (Pr)n	48.15	36.82	15.02
S.Z (Pr)n	50.6	36.89	12.51
S.Z (Ko)n	52.54	38.64	8.82
K (Shk)n	44.83	41.63	13.54
Sh.Z (Vl)n	49.47	36.42	14.11
Sh.Z (Tr)n	51.1	36.43	12.47
C.S (Br)n	45.51	36.93	17.56
M (Br)n	46.37	35.52	18.11
D.Z (Pr)o	43.89	46.72	9.39
S.Z (Pr)o	39	52.5	8.5
S.Z (Ko)o	42.29	47.83	9.88
K (Shk)o	37.5	53.32	9.18
Sh.Z (Vl)o	44.49	42.59	12.92
Sh.Z (Tr)o	44.29	43.02	12.68
C.S (Br)o	43.74	42.59	13.67
M (Br)o	44.19	44.85	10.95

Table 2. The experimental results of wine samples obtained according to CIE 1964 (x, y) color system (CIEXYZ) and CIELAB coordinates

Variety, zone	Color	Tristimulus value			Chromaticity coordinates			CIELAB coordinates		
		X	Y	Z	x	y	z	a*	b*	L*
D.Z (Pr)n	Red	32.48	18.48	2.88	0.6	0.34	0.053	65.03	54.07	50.07
S.Z (Pr)n	Reddish-orange	56.49	38.63	7.84	0.55	0.37	0.076	56.56	62.07	68.48
S.Z(Ko)n	Reddish-orange	38.46	22.62	2.27	0.61	0.36	0.036	65.46	66.56	54.68
K (Shk)n	Red	64.87	51.45	13.11	0.5	0.39	0.101	39.91	77	76.95
Sh.Z(Vl)n	Reddish-orange	65.24	49.06	12.62	0.51	0.39	0.099	47.05	59.78	75.49
Sh.Z(Tr)n	Orange-pink	59.91	44.73	11	0.52	0.39	0.095	46.65	59.39	72.71
C.S (Br)n	Orange-pink	52.14	37.45	8.16	0.53	0.38	0.083	49.23	59.44	67.61
M (Br)n	Reddish-orange	37.63	25.22	5.07	0.55	0.37	0.075	51.52	54.08	57.29
D.Z (Pr)o	Orange	42.23	28.04	1.83	0.59	0.39	0.025	54.55	79.44	59.92
S.Z (Pr)o	Orange	75.59	60.91	10.48	0.51	0.41	0.08	39.76	77.45	82.33
S.Z (Ko)o	Orange	34.81	21.59	0.99	0.61	0.38	0.02	58.06	78.07	53.59
K (Shk)o	Orange	35.43	23.35	0.49	0.59	0.39	0.008	52.24	88.46	55.43
Sh.Z(Vl)o	Orange	71.38	43.78	4.22	0.59	0.37	0.035	75.17	83.87	72.08
Sh.Z (Tr)o	Reddish-orange	70.78	44.38	2.9	0.6	0.38	0.025	72.17	92.55	72.48
C.S (Br)o	Orange	126.59	85.41	9.68	0.57	0.38	0.04	76.16	100.08	94.06
M (Br)o	Orange	103.37	65.43	4.99	0.59	0.38	0.029	80.52	101.72	84.7

sauvignon followed by Merlot and Serin i zi. The a* parameter show an increase for Shesh i zi and Kallmet during ageing, the same way it happens in Merlot and Cabernet sauvignon, while it decreases in Serin i zi and Debin e zeze. For the b* parameter we see an increase for all wines in study, which correspond with changing from clearer red zone to orange-red during ageing (given by chromaticity coordinates).

This results shows that both systems (CIESYZ) and CIELAB) could be used to evaluate changes in lightness (Y and L, respectively), in redness (a*) and yellowness (b*).

In conclusion, with regard to color parameters, ageing leads to an increase in the luminance and hue, whereas and color intensity decrease. Hence, the color parameters of Shesh i zi wine are comparable to Merlot and Cabernet sauvignon wine, this native variety could be used for ageing, while the other varieties need to consume within the first year of production. Results show that our climatic conditions favor the development of many varieties suitable for creating quality wines such as Merlot and Cabernet sauvignon, which are very well adapted to the Albanian micro-climate. Seeing the potential of color expressed from local and international varieties, we can say that there is the possibility of blending two or more wines (international and local varieties) in creating quality wines with body and suitable for ageing.

4. Conclusion

This study presented a good objective evaluation of color parameters in red wines by using simpler methods and tristimulus CIE parameters. While wine is maturating color intensity decreases and tint increases. The evolution of wine color during maturing process depends on their variety and composition. Color parameters of Shesh i zi wines are comparable with world famous wines produced from grape varieties Cabernet sauvignon and Merlot grown in Albanian territory. As a conclusion Shesh i zi could be used for ageing, while the other varieties need to be consumed within the first year of production. From color results there is the possibility of blending our local varieties with international varieties so we can have premium wines with body, intensive color and suitable for ageing.

5. References

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