Research on quality of red wine varieties, obtained at Bujoru Vineyard, Dealu Bujorului Wine Center, Romania

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Abstract. The ecoclimatic conditions advantageous for the grapevine growth fall into two categories: indispensable conditions and critical natural conditions. The indispensable conditions have negative influences on the growth and fruition of grapevine, resulting in a decreased production both for quantitative and qualitative respects. The purpose of this paper was to trace the influence of the ecoclimatic conditions of 2013-2014-2015 over the quality of grapevine varieties used for high-quality wines. The used biological material was represented by Merlot, Cabernet Sauvignon and Fetească Neagră. Determination was conducted in accordance with international standards for determining wine quality (O.I.V). The alcohol content varies in large limits 12.5% vol. in Fetească Neagră (2013) and 16.37% vol. in 2015. Regarding the total acidity, Merlot variety, recorded the lowest value 6.07 g/L tartaric acid (2015) while the Fetească Neagră variety has recorded the highest value 7.60 g/L tartaric acid. Volatile acidity to Fetească Neagră (2013) was 0.34 g/L acetic acid, the highest value was recorded at Merlot (2015) of 0.65 g/L acetic acid. Free SO_2 content and the total recorded in the normal range, the highest values were recorded Cabernet Sauvignon (2014) 26.33 mg/L (free SO_2) and Merlot (2013) 121.67 mg/L (total SO_2) in contrast with the lowest values were recorded in Feteasca Neagră (2015) 16.0 mg/L (free SO_2) and 59.67 (total SO_2) the Feteasca Neagră (2014). Potassium recorded values between 778.67 mg/L Merlot (2013) and 1179.67 mg/L to Fetească Neagră (2015). Calcium content values ranged between 77.87 mg/L Merlot (2013) and 115.30 mg/L Cabernet Sauvignon (2013). The largest iron content was recorded at Feteasca Neagră (2015) 0.54 mg/L, and the opposite with the lowest concentration was recorded at Merlot (2013) 0.36 mg/L, while copper and lactic acid was below the detection limit. The ecoclimatic conditions studied in Dealu Bujorului distinguished the exceptional viticultural character of this wine area and the nature of authenticity present in the large variety of wines produced in the areas studied. Regarding the qualitative assessment of the eight varieties taken under testing, based on the results can be observed that the varieties have good suitability in the studied area and in terms of quality assessment, they show the particularities of the varieties and also the influence of the eco climatic and ecopedological conditions on wine quality. The results of the research indicate very good ecoclimatic conditions for the cultivation of grapevines in the Dealu Bujorului Vineyard, as well as a good suitability for the tested varieties in order to be cultivated as to achieve a superior quality wine.
Key Words: grapevine, ecoclimatic conditions, fruition, Romanian vine varieties, *Vitis vinifera*.

Rezumat. Condițiile ecoclimatice favorabile culturii viței de vie, se împart în două categorii: condiții indispensabile și condiții naturale critice. Condițiile indispensabile au rol important și favorizează în mod direct creșterea și fructificarea viței de vie, dintre acești factori indispensabili amintim radiația solară, temperatura, lumina, dar și umiditatea. Condițiile critice naturale, influențează în mod negativ creșterea și fructificarea viței de vie, ducând la scăderea producției sub aspect cantitativ și calitativ. Prin prezenta lucrare s-a urmărit influența condițiilor ecoclimatice din anul 2013, 2014, 2015 asupra calității unor soiuri de viță de vie pentru vin alb de calitate superioară. Materialul biologic utilizat a fost reprezentat de soiurile Merlot, Cabernet Sauvigon și Feteasă Neagră. Determinarările s-au realizat în conform cu standardele internaționale pentru determinarea calității vinului (O.I.V). Conținutul în alcool variază în limite foarte largi 12,5 % vol. la soiul Fetească Neagră (2013) şi 16,37% vol. în anul 2015. Privitor la aciditatea totală a soiului Merlot a oscilat între 6,07 g/L acid tartric (2015) şi 7,60 g/L acid tartric. Aciditatea volatilă la soiul Fetească Neagră (2013) a fost de 0,34 g/L acid acetic, cea mai mari valoare a fost înregistrată la Merlot (2015) de 0,65 g/L acid acetic. Conținutul de SO_2 liber dar și cel total s-a înregistrat în limite normale, cele mai mari valori au fost înregistrate la soiul Cabernet Sauvignon(2014) 26,33 mg/L (SO_2 liber) și Merlot (2013) de 121,67 mg/L (SO_2 total), la polul opus cu cele mai mici valori

au fost înregistrate la soiul Feteasca Neagră (2015) de 16.0 mg/L (SO_2 liber) şi 59.67 (SO_2 total) la soiul Feteasca Neagră (2014). Potasiu a înregistrat valori cuprinse între 778,67 mg/L la soiul Merlot (2013) şi 1179,67 mg/L la soiul Fetească neagra (2015). Conţinul de calciu a oscilat intre valorile 77,87 mg/L la soiul Merlot (2013)şi 115,30 mg/L la soiul Cabernet Sauvignon (2013). Cel mai mare conținut de fier s-a înregistrat la soiul Feteasca Neagră (2015) de 0,54 mg/L, iar la polul opus cu cea mai mică concentrație a fost înregistrată la soiul Merlot (2013) de 0,36 mg/L, în timp ce cuprul dar și acidul lactic a fost sub limita de detecție. Condițiile ecoclimatice studiate în podgoria Dealu Bujorului, au scos în evidență caracterul viticol excepțional al acestui areal viticol, precum și caracterul de autenticitate prezent în paleta variată de vinuri obținute în arealele luate în studiu. În ceea ce privește evaluarea calitativă a celor opt soiuri luate în testare, pe baza rezultatelor se poate observă că, soiurile au o bună pretabilitate în arealul luat în studiu, iar în ceea ce privește determinările calitative, acestea scot în evidență caracterele de soi particulare ale acestor, dar și influența condițiilor ecoclimate și ecopedologice asupra calității vinului. Rezultatele cercetărilor indică condiții ecoclimatice foarte bune pentru cultivarea viței de vie în podgoria Dealul Bujorului, dar și o bună pretabilitate a soiurilor luate în testate, pentru cultivarea lor în vederea obținerii unui vin de calitate superioară.
Cuvinte cheie: vița de vie, podgoria Dealu Bujorului, soiuri de vița de vie românești, *Vitis vinifera*.

Introduction. Due to recent global warming, manifested in the last period of time directly affects the fructification and also growth of grapevine as other plants. There were studied the consequences of ecoclimatic conditions in viticulture: grapes, must and also wine (Bonnefoy et al 2010; Duchêne et al 2010; Tomasi et al 2011). Studies on mechanism of genetic (Burzo et al 2005) and physiological adaptation (Duchêne et al 2010; Schultz 2010) as well as on new strategies to these new conditions for viticulture (Carbonneau et al 2010; Carbonneau 2011). The latest researches in this field regard the grapevine adaptations to water stress, conditions changing climate effects on grapes productions, physico-chemical composition of grapes, area footprint of the wine and also pathogens behavior. Today the importance this topic is given by the recently created OIV group of experts „Viticultural Environment and Climate Change" that have developed the guidelines for studies on the effects of ecoclimatic conditions changes in vitiviniculture and proposed adaptations (OIV 2012).

The wine although it is fermented juice of the grape, differs very much not only by aroma, taste and density, but through its chemical composition. Wine is a food product exclusively obtained by partial or total alcoholic fermentation, of fresh grapes or of the must obtained from pressed or unpressed grape. From a chemical point of view, wine is a complex product consisting of water, ethanol, sugars, amino acids, anthocyanins, polyphenolic compounds, inorganic and organic compounds (Dalipi et al 2015; Karataș et al 2015; Bora et al 2013, 2014, 2015a; Katalinic et al 2004; Monaci et al 2003; Voica et al 2009). Wine composition is influenced by many factors related to the specific production area, like grape variety, soil and climate, ripening of the grapes and winemaking technology (Gonzálvez et al 2009; La Torre et al 2006; Bora et al 2015b).

The grapevine is now cultivated all over the world, Europe has the highest percentage 51% of the global surface cultivated with vine, followed by America, Asia and Africa (Gonçalves da Silva et al 2008). The wine growing area in Romania has decreased since the 1990s, currently it ranks fifth in Europe after, Spain, Italy, Portugal and France, so that in 2013 Romania had area of 229,000 hectares planted with vines (Bora et al 2014).

The favorable climatic conditions for the grapevine growing fall in two categories: vital conditions and natural critical ones. The vital conditions are important and directly influence the growth and fructification of the grapevines; the factors worth being mentioned are as follows: temperature, solar radiation, light and humidity. The natural critical conditions, aversely affect growth and fructification of the grapevine, resulting in a decreased production both in terms of quality and quantity (Pop 2010). The quality of grapes is also directly influenced by ecoclimatic conditions, variety, and the level of applied agro-technical works (Bunea 2010). According to other researchers, the grape quality is directly influenced by the variety, ecolimatic conditions, agro-technical works applied and zoning (Condurso et al 2015; Rotaru et al 2010).

The Romanian wine industry is particularly involved in the controversial effects posed by the climate changes, even if the overall effects of the climate change on the Romanian viticulture are very uncertain, it is known that the productivity, an increase in the soil salinity and drought due to different effect on grape quality. The phenomenon of aridity affects the Romanian vineyards, especially during the growing season (Păltineanu et al 2007).

The effects were numerous and classified as direct in the relevant literature (Dalla et al 2010), as the climate changes influence the onset and duration of each phenological phase, it also affects grape production in terms of quality and quantity. All these climate changes affect the viticulture, after the relationship between plants and pests, and between pathogens and weeds, and farmers have a very limited time to solve these problems. In addition, changes can also occur due to the long-term responses of farmers. These phenomena, along with the movement of the suitable areas for growing grapes, produced by the climate changes, are the main forces that lead to changes in the land usage in long-terms (Holland & Smit 2010).

The grapes and wine quality is directly influenced by many factors, such as natural and human factors: soil (physico-chemical characteristics of the soil), variety and ecoclimatic conditions, the cultivation, the process of wine making and the wine transportation and storage (Marini et al 2006; Voica et al 2009).

The acknowledgement of the health benefits of catechins and procyanidins lead to the use of grape seed extract as antioxidant food supplement. The main phenolic antioxidants can also be used to preserve food supplement because of their protective effects against microorganisms antimicrobial phenolic compounds found in grape seeds, husks and stem extracts (Jayaprakasha et al 2003; Butkhup et al 2010).

The effects of climate change on the wine production were presented in detail in the relevant literature, due to the role of this industry in agro-food economic world, due to the spread of viticulture in new areas that have not practiced previously, and to the various effects of global warming and weather fluctuations on the cultivation (Schultz 2000; Tate 2001).

Material and Method. The samples of wine used in this research were represented by wine produced from Merlot, Cabernet Sauvignon and Feteasca Neagră from 2015 wine production in the culture conditions of the Dealu Bujorului Vineyard. The wine samples were obtained under microwine production.

To characterize the researched area, the weather data used was recorded at the weather forecasting center and Agro Expert system of RSDVV Bujoru. Based on this data, the ecoclimatic important indicators for the growth and fructification of the grapevine are determined: global thermal balance ($\Sigma t^o g$), active balance ($\Sigma t^o a$), balance due ($\Sigma t^o u$), thermal coefficient (Ct), amount of annual and monthly precipitation, amount of hours with sun (Σir) and real insolation coefficient (Ci). Ct is given by the ratio of the overall balance ($\Sigma t^o g$) (^0C) and number of days in the active period, Ci is given by the ratio between the hours with sun and the growing season days. Cp is given by the ratio between the rainfall of the growing season (mm) and number of days of the growing season. In order to get a clearer picture about how climatic factors influence the growth and fruition of the grapevines, the helioclimatic index (HI), hydrothermal coefficient, and bioclimatic vineyard index were calculated.

The physical and chemical analyses of wine were performed in the laboratory of winemaking in the RSDVV Bujoru and were according to the methods of analysis described in the Compendium of international methods of analysis of wines and musts to O.I.V. and to the Romanian STAS methods. The following parameters were determined: alcohol (% vol.), total acidity (g/L $C_4H_6O_6$), volatile acidity (g/L CH_3COOH), free SO_2 (mg/L), total SO_2 (mg/L); sugar (mg/L), pH, acetic acid (g/L), potassium (mg/L), calcium (mg/L), amino nitrogen (mg/L), tartaric acid (g/L), copper (mg/L), l-lactic acid (g/L), iron (mg/L), l-malic acid (g/L), D-gluconic acid (g/L), glycerol (g/L).

In order to get a wider picture about the quality of the wine and for determining the acetic acid, potassium, calcium, amino nitrogen, tartaric acid, copper, L-lactic acid, iron, L-malic acid, D-gluconate and glycerol, the Miura ONE device was used, and the operating parameters are displayed in Table 1. The pH level was determined using WTW inoLab pH 7110.

Table 1

Working parameters for MIURA ONE

Studied parameter	*Correlation coefficient*	*Dilution rate*
Acetic acid	0.9999	1:1, 1:2, 1:5, 1:30, 1:1
Potassium	0.9999	1:1, 1:2, 1:4, 1:10, 1:16, 1:1
Calcium	0.9999	1:1, 1:2, 1:4, 1:10, 1:1
Amino nitrogen	0.9999	1:1, 1:2, 1:4, 1:10, 1:1
Tartaric acid	0.9999	1:1, 1:2, 1:4, 1:10, 1:1
Copper	0.9999	1:1, 1:2, 1:4, 1:10, 1:1
L-Lactic acid	0.9999	1:1, 1:2, 1:3, 1:4, 1:1
Iron	0.9999	1:1, 1:2, 1:3, 1:4, 1:1
L-Malic acid	0.9999	1:1, 1:2, 1:4, 1:7, 1:1
D-Gluconic acid	0.9999	1:1, 1:2, 1:4, 1:6, 1:1
Glycerol	0.9999	1:1, 1:2, 1:4, 1:10, 1:1

The statistical interpretation of the results was performed using the Duncan test, SPSS Version 23 (SPSS Inc., Chicago, IL., USA). The statistical processing of the results was primarily performed in order to calculate the following statistical parameters: arithmetic average, average error, standard deviation. This data was interpreted with the analysis of variance (ANOVA) and the average separation was performed with the DUNCAN test at $p \leq 0.005$. In order to determine whether the major wine quality parameters may affect each other, correlation coefficient was calculated using SPSS version 23 Person (SPSS Inc., Chicago, IL., USA).

Results and Discussion. The duration of the growing season is within normal limits, over 170 days, for the culture of grapevines, and in 2015 this limit was exceeded: 190 days for Dealu Bujorului Vineyard, Bujoru Wine Centre. In the experimental year 2015 the thermal balance recorded the following values: global thermal balance ($\Sigma t^0 g$) 3463.8ºC, active thermal balance ($\Sigma t^0 a$) 3357.6ºC and useful thermal balance ($\Sigma t^0 u$) 1678.6°C.

The precipitation quantity in 2015 was low (510.8 mm). In January, February, March, August and October a surplus was recorded, while in the remaining months an accentuated deficit was registered. During the growing season, the recorded value was 218.2 mm, below the annual average of 296.0 mm for Bujoru Wine Centre. Under these conditions, the relative humidity values of air are much lower than the annual average, between 55.6 and 58.6% in the months during the growing season.

The insolation measured by the number of hours of sunshine was higher than normal in the months during the growing season, with 1,480.5 hours over the normal 1,316 hours.

In the climatic conditions of 2015, the heliothermal real index (IHr) value was 2.48 falling within the limits described in the literature (1.35 and 2.70), which shows an increase in the heliothermal resources and optimal conditions for the ripening of late maturing variety. The hydrothermal coefficient (CH) had a very low value of 0.65, compared to the normal limits for our country, between 0.7 and 1.8, indicating that the humidity was insufficient, with recommendation for irrigation, for both the wine varieties and for table grapes. The viticultural bioclimatic index (Ibcv) with a value of 11.99 for 2015 that the heliothermal resources recorded high values due to low hydrous resources for the Bujoru Wine Centre.

Table 2

Ecoclimatic conditions of Dealu Bujorului 2015

Area	*Climate conditions*		*Specific*			*Breakpoint for vines*
			Average	*Extremes*		
				Minimum	*Maximum*	
	The vegetation period	*Days*	*190*	*173*	*186*	*160-180*
Bujor	Thermal balance	Global ($\sum t^0g$)	3463.8	3125	3837	2700-4000
		Active ($\sum t^0a$)	3357.6	3201	3871	2500-3800
		Beneficial ($\sum t^0u$)	1678.6	1432	1639	1000-1800
		Thermic coefficient (C_t)	17.7	16.2	18.5	16-19
		Minimum absolute air temp. ^{0}C	-23.0	-23.0	-	-
		Maximum absolute temp. ^{0}C	37.3	-	37.3	-
		Avg. max. temp. August ^{0}C	30.5	-	-	-
		Avg. temp. decade I & II June ^{0}C	20.8	-	-	-
		No. of days max temp. >30^{0}C	69	-	-	-
	Insolation (hours)	Real ($\sum$ir)	2024.8	1370	1678	1200-1800
		$\sum$ hours of insolation in the growing season (mm)	1480.5	-	-	-
		Insolation coefficient (C_i)	7.8	6.66	8.57	7-9 ore
	Precipitations (mm)	$\sum$ precipitations in the growing season	218.2	-	-	-
		Annual ($\sum$pp)	510.8	431.8	529.1	500-700
		Precipitation coefficient (Cp)	1.1	0.98	2.02	0.9-2.7
	Interaction of climate factors	Heliothermal real index(IH_r)	2.48	2.06	2.34	1.35-2.70
		Hydrothermal coefficient (CH)	0.65	1.04	1.70	0.7
		Bioclimatic vineyard index (I_{bcv})	11.99	5.3	7.9	5
		Oenoclimatic skills index (IAOe)	4870.9	-	-	-
		Annual aridity index Martonne (I_{ar-DM})	23.8	-	-	-
		Heliothermal Huglin index (IH) in the growing season	2256	-	-	-
		Cooling nights index (IF)	12.9	-	-	-

The oenoclimatic suitability index (IAOe) had a value of 4870.9 indicating an area with favorable conditions for the growing of red varieties of grapes for wine. The Martonne aridity index had a value of 7.56 during the growing season, indicating a semiarid forest steppe climate. The heliothermal Huglin index provide necessary information regarding the thermal potential for the culture of grapes, both for table and wine, with different periods of ripening. Compared to other heliothermal indices, it displays a close link with the sugar from the must. The sum of the Huglin index during the growing season was 2,256.0. The night cooler index was (IF) and is involved especially during the ripening season, this value was obtained by summing up the minimum temperatures of the month. The IF index was calculated only for September and the obtained value was 12.9 value that encloses in the range of 12-14 corresponding to the climate with cool nights class.

The ecoclimatic conditions studied in Dealu Bujorului Vineyard, Bujoru Wine Centre, highlighted the exceptional viticultural character of Romania, and the authenticity one, encountered in a large variety of wines produced in the studied areas.

Analysis of the main quality parameters of red wine at the Dealu Bujorului Vineyard, Bujoru Wine Centre. Regarding the alcohol content of the tested wines, based on the results, we can state that the highest alcohol content was recorded in the Feteasca Neagră variety (16.3±0.15 [% vol.] 2014), followed by the same variety (15.90±0.10 [% vol.] 2014). The lowest alcohol content was recorded in the Merlot variety (13.60±0.10 [% vol.] 2013) and Feteasca Neagră (12.50±0.10 [% vol.] 2013). It can also be seen that between the studied variants, the differences were significant ($F = 215.550$, $p \leq 0.000$) (Table 3). We can see that the variety factor had a very significant influence ($F = 302797.620$, $p \leq 0.000$), followed by years factor ($F = 99.060$, $p \leq 0.000$) also had very significant influence. In this case the interaction of the two factors (variety x year had a very significant influence on this character ($F = 218.940$, $p \leq 0.000$).

The results are comparable with the results reported by de Bruijn et al 2014 (13.30±0.10 [% vol.], 12.30±0.10 [% vol.] Sauvignon Blanc wines), Miličević et al 2014 (13.20±0.10 [% vol.] Syrah), Trigo-Córdoba et al 2015 (13.60±0.00 [% vol.] Godello [white wine], and Baiano et al 2015 (11.44±0.11 [% vol.] Nero din Troia [red wine]).

The total acidity is an important quality parameter that can be determined/ controlled in wine. The wine must have a minimum content of 4.5 g/L total acidity expressed as tartaric acid (60 mechiv./L). The lacking of acidity induces a flat taste in wine and a weak storage endurance (mainly affected by the lactic acid bacteria and propionic). The highest level of acidity was registered in the Feteasca Neagră variety (7.60±0.10 [g/L $C_4H_6O_6$) 2015) followed by the same variety (7.20±0.10 [g/L $C_4H_6O_6$] 2013). In contrast, the lowest acidity level was recorded in the Cabernet Sauvignon (6.27±0.15 [g/L $C_4H_6O_6$] 2015) and Merlot varieties (6.07±0.15 [g/L $C_4H_6O_6$] 2015). It can also be seen that between the studied variants, the differences were significant ($F = 60.640$, $p \leq 0.000$) (Table 3).

The results are comparable with data obtained by Budić-Leto et al 2009 (4.68±0.03 [g/L $C_4H_6O_6$]), and Miličević et al 2014 (5.50 ± 0.15 [g / L $C_4H_6O_6$] Syrah).

The volatile acidity sums up all the volatile fatty acids from the acetic series that can be found in wine in a free state or in the form of salts: acetic acid, formic, propionic, butyric, valeric, isovaleric. It represents about one tenth of the wine acidity. The varieties Feteasca Neagră (0.41±0.01 [g/L CH_3COOH] 2014), followed by the same variety (0.41±0.01 [g/L CH_3COOH]) recorded the lowest level of volatile acidity compared with Merlot (0.65±0.01 [g/L CH_3COOH] 2015) and Cabernet Sauvignon (0.59±0.01 [g/L CH_3COOH]) with the highest volatile acidity (Table 3).

The results are comparable with those reported by de Bruijn et al 2014 (0.50±0.00 [g/L CH_3COOH], 0.40±0.00 [g/L CH_3COOH] Sauvignon Blanc wines), Miličević et al 2014 (0.46±0.20 [g/L CH_3COO]) Syrah), and greater than those obtained by Baiano et al 2015 (0.12±0.01 [g/L CH_3COO]).

Table 3

Analysis of the main quality parameters of the wine obtained at Dealu Bujorului Vineyard

Area	*Variety*	*Year*	*Studied parameter*							
			Alcohol (% vol.)	*Total acidity (g/L $C_4H_6O_6$)*	*Volatile acidity (g/L CH_3COOH)*	*Free SO_2 (mg/L)*	*Total SO_2 (mg/L)*	*Sugar (mg/L)*	*Non–reducing extract (g/L)*	*Glycerol (g/L)*
Dealu Bujorului	Merlot	2013	13.60 ± 0.10^{f} γ	6.20 ± 0.10^{ef} αβ	0.46 ± 0.01^{de} β	18.00 ± 1.00^{cd} β	121.67 ± 2.08^{a} α	7.67 ± 0.15^{c} α	26.87 ± 0.15^{e} β	7.77 ± 0.15^{e} β
		2014	14.60 ± 0.20^{c} α	6.37 ± 0.15^{d} α	0.48 ± 0.02^{d} β	18.33 ± 0.58^{cd} β	65.00 ± 1.00^{e} γ	7.30 ± 0.10^{d} β	25.87 ± 0.34^{f} γ	8.53 ± 0.15^{bc} α
		2015	14.00 ± 0.10^{e} β	6.07 ± 0.15^{f} β	0.65 ± 0.01^{a} α	22.33 ± 1.53^{b} α	73.67 ± 2.52^{c} β	1.00 ± 0.10^{h} γ	27.40 ± 0.13^{d} α	8.70 ± 0.10^{ab} α
		Avg.1	14.06±0.13	6.21±0.13	0.53±0.01	19.55±1.37	86.78±1.86	5.32±0.11	26.71±0.20	8.33±0.13
	Cabernet Sauvignon	2013	14.30 ± 0.10^{d} α	6.27 ± 0.06^{ef} β	0.59 ± 0.01^{b} α	18.66 ± 1.53^{c} β	64.33 ± 1.53^{e} β	4.83 ± 0.15^{e} β	24.43 ± 0.63^{g} γ	7.93 ± 0.21^{de} β
		2014	14.20 ± 0.10^{de} α	7.20 ± 0.10^{b} α	0.45 ± 0.02^{e} γ	26.33 ± 1.93^{a} α	109.00 ± 2.00^{b} α	10.67 ± 0.15^{b} α	29.73 ± 0.26^{c} β	8.80 ± 0.20^{ab} α
		2015	14.23 ± 0.21^{de} α	6.27 ± 0.15^{ef} β	0.54 ± 0.03^{c} β	17.00 ± 1.00^{cd} β	67.33 ± 2.52^{de} β	1.87 ± 0.39^{g} γ	30.87 ± 0.39^{b} α	8.60 ± 0.26^{b} α
		Avg.1	14.24±0.13	6.58±0.10	0.52±0.01	20.66±1.48	80.22±2.01	5.79±0.23	28.34±0.42	8.44±0.22
	Feteasca Neagră	2013	12.50 ± 0.10^{g} γ	7.20 ± 0.10^{b} β	0.34 ± 0.01^{g} γ	18.33 ± 1.53^{cd} α	108.67 ± 1.53^{b} α	4.50 ± 0.10^{f} β	26.87 ± 0.06^{e} β	8.23 ± 0.25^{c} β
		2014	15.90 ± 0.10^{b} β	6.83 ± 0.15^{c} γ	0.41 ± 0.01^{f} β	18.33 ± 0.85^{cd} α	59.67 ± 2.52^{f} γ	12.40 ± 0.10^{a} α	30.83 ± 0.57^{b} α	8.97 ± 0.15^{a} α
		2015	16.37 ± 0.15^{a} α	7.60 ± 0.10^{a} α	0.54 ± 0.03^{c} α	16.00 ± 1.00^{d} α	69.67 ± 0.58^{d} β	4.47 ± 0.46^{f} β	31.43 ± 0.45^{a} α	8.80 ± 0.10^{ab} α
		Avg.1	14.92±0.11	7.21±0.11	0.43±0.01	17.55±1.12	79.33±1.54	7.12±0.22	29.71±0.36	8.66±0.16
Avg.2			14.40±0.12	6.66±0.11	0.49±0.01	19.25±1.32	82.11±1.80	6.07±0.18	28.25±0.32	8.47±0.17
F (Fisher Factor)			215.550	60.640	113.88	17.939	460.687	2481.654	358.631	15.141
Sig.			p≤0.000	p≤0.000	p≤0.000	p≤0.000	p≤0.000	p≤0.000	p≤0.000	p≤0.000
Variety		F	302797.620	151.683	119.554	13.422	40.170	451.149	383.350	7.609
		Sig.	***	***	***	***	***	***	***	**
Year		F	99.060	9.073	188.415	12.289	508.770	7684.915	667.217	50.554
		Sig.	***	**	***	***	***	***	***	***
Variety x Year		F	218.940	40.902	73.792	23.022	646.905	895.277	191.979	1.201
		Sig.	***	***	***	***	***	***	***	ns

Average values, ± standard deviation (n=3). Romans represent the significance of the variety difference (p≤0.05). Greeks represent the significance of the same variety cultivated in other year's difference (p≤0.05). The difference between any two values, followed by a common letter is insignificant.
AVG.1 = the average of all variants analyzed;
AVG.2 = the average of variants depending on the year.

Regarding the free sulfur dioxide (free SO_2) content of wine, Cabernet Sauvignon variety recorded the highest content (26.33±1.93 mg/L, 2014), followed by Merlot variety (22.33±1.53 mg/L, 2015), at the opposite pole is situated the Merlot variety (18.00±1.00 mg/L, 2013 and 18.33±0.58 mg/L, 2014), Cabernet Sauvignon variety (18.66±1.53 mg/L, 2013), Fetească Neagră variety (18.33±1.53 mg/L, 2013 and 18.33±0.85 mg/L, 2014) variants which are statistically equal, followed by Cabernet Sauvignon variety (17.00±1.00 mg/L, 2015). This is due to use of a smaller quantity of sulfur dioxide for clarifying and preserving the wine. The differences between variants were statistically assured (F = 17.939, p≤0.000) (Table 3).

Comparing the results of free SO_2 content with the legislation, it can be seen that all produced wines have a much lower content than the one required by low, therefore the wine can be consumed/preserved.

The highest amount of total SO_2 was registered in wine from Merlot variety (121.67±2.08 mg/L, 2013) followed by Cabernet Sauvignon (109.00±2.00 mg/L, 2014). The lowest amount of total SO_2 was registered in wine from Fetească Neagră (59.67±2.52 mg/L, 2014). In this case the interaction of the two factors (variety x year) had a very significant influence on this character (F = 646.905, p≤0.000).

The not fermented sugars in the wine (residual sugar) are small and variable amounts, usually between 5-80 g/L, rarely more. Dry wines contain 2-3 g/L of sugars and do not jeopardize the wine conservation/preservation. The amounts of 2-5 g/L of sugar, give a smoother taste and easier appreciable density, around 1,000 to the wine. More than 5 g/L of sugar makes the wine to acquire a sweet clean taste, and the presence of sugars makes it fragile to microorganisms. We can see that the analyzed varieties present significant differences (F = 2481.654, p≤0.000). The Fetească Neagră variety displayed the highest sugar content (12.40±0.10 mg/L, 2014), while the Cabernet Sauvignon (1.87±0.39 mg/L, 2015) and Merlot (1.00±0.10 mg/L, 2015). We can see that the year factor had a very significant influence (F = 7684.915, p≤0.000), followed by variety factor (F = 451.149, p≤0.000) also had very significant influence. In this case the interaction of the two factors (variety x year) had a very significant influence on this character (F = 895.277, p≤0.000) (Table 3).

The results are comparable with those reported by Miličević et al 2014 (2.85±0.25 mg/L, Syrah).

The dry extract or non-reducing refers to the assembly of all substances from wine or the substances that do not volatilize under well-established physical laboratory conditions. Such substances are found in a dissolved state or as colloidal suspension, and their chemical nature is very different. The Fetească Neagră variety recorded the highest valuable of unreducible extract (31.43±0.45 g/L, 2015), followed by the same variety (30.83±0.57 g/L, 2014), in the opposite can be observed the Fetească Neagră (26.87±0.06 g/L, 2013) and Merlot (25.87±0.34 g/L, 2014) (Table 3).

After water and alcohol, the glycerol is the most abundant in wine 5-15 g/L, depending on the health of the crop and the type of wine (dry or sweet). The wines from Tokaji Aszú are richer in glycerol, reaching up to 27 g/L and also the wines produced using high dosages of SO_2 in the processing of grapes. The large amount of glycerol formed during the fermentation contributes to maintaining the redox balance of the wine and to the osmotic stress adjustment of yeast in the case of sugars abundant from musts.

The Fetească Neagră variety recorded the highest concentration of glycerol (8.97±0.15 g/L, 2014), followed by Merlot (8.70±0.10 g/L, 2015), Cabernet Sauvignon (8.80±0.20 g/L, 2014) and Fetească Neagră (8.80±0.10 g/L, 2015), which are equal in terms of statistics. The lowest concentration of glycerol was registered in the Merlot variety (7.77±0.15 g/L, 2013). The difference between the varieties was statistical assured (F = 15.141, p≤0.000) (Table 3).

By their very complex molecular structure phenolic compounds has a high chemical activity and give birth to numerous wine oxidation processes, condensation, polymerization and copolymerization. In general phenolic compounds affect the color and taste of the wine qualities (flavor, astringency, hardness of wine tasted). Phenolic compounds from wine are divided into two categories: coloring phenolic compounds (anthocyanins, flavones) that give wine color and colorless phenolic compounds (phenolic acids, volatile phenols and tannins) that give wines phenolic character. The lastest research has revealed the overwhelming role of phenolic compunds on the quality of wines, physi-chemical processes from wine which they participate, especially sanogenetic effects of phenolic compounds on the human body (Țârdea et al 2000).

Regarding the total polyphenols content of the tested wines, based on the results, we can state that the highest polyphenols content was recorded in the Cabernet Sauvignon variety (2.33±0.02 g/L, 2014) followed by Fetească Neagră variety (2.10±.10 g/L, 2015). The lowest polyphenols was recorded in Merlot variety (1.20±0.02 g/L, 2014) and Cabernet Sauvignon variety (1.14±0.02 g/L, 2013). It can also be seen that between the studied variants, the differences were significant ($F = 114.947$, $p \leq 0.000$) (Table 4). We can see that the years factor had a very significant influence ($F = 415.783$, $p \leq 0.000$), followed by variety factor ($F = 12.727$, $p \leq 0.000$) also had very significant influence. In this case the interaction of the two factors (variety x year) had a very significant influence on this character ($F = 15.640$, $p \leq 0.000$) (Table 4).

The trademark color of red wines is essential quality with which first addresses to a wine consumers. Chromatic shades are very diverse: white, greenish white, ivory, yellow, yellow-green, golden-yellow, pink, lilac-pink, red, purple, red-purple and so on. Optical color resulting from selective absorption of radiation that make up the solar spectrum elementary (daylight), therefore chromatic characterization of wine refers to determining the absorbance of light radiation. To characterize the color of the red wine are determined color intensity (CI) and hade or tint color (TC). For this purpose is measured absorbance or optical density of the wine (OD) at wavelengths of 420, 520 and 620 nm. Color intensity (CI) of wine is by adding optical densities ($CI = OD_{420}+OD_{420}+OD_{620}$) (Țârdea et al 2000). Coloring intensity was measured at 1 mm cuvette.

The Fetească Neagră variety recorded the highest color intensity (9.54±0.05, 2015), followed by Cabernet Sauvignon variety (9.05±0.05, 2015), Merlot variety (8.74±0.06, 2014). The lowest color intensity was registered in the Fetească Neagră variety (8.27±0.03, 2014) and by Cabernet Sauvignon variety (7.91±0.14, 2014). The difference between the varieties was statistical ($F = 260.920$, $p \leq 0.000$) (Table 4).

Since the color of wine is considered an overlay of red color measured at 520 nm and yellow color measured at 420 nm, the color tint (CT) is evaluated as $CT = OD_{420} / OD_{520}$ (Țârdea et al 2000). Color tint was measured at 1 mm cuvette.

Regarding the color tint of the tested wines, based on the results, we can state that the highest color tint was recorded in the Merlot variety (0.81±0.04, 2014) followed by Cabernet Sauvignon variety (0.78±0.02, 2015). The lowest color tint was recorded in Merlot variety (0.68±0.02, 2014) and Cabernet Sauvignon variety (0.69±0.02, 2013). It can also be seen that between the studied variants, the differences were significant ($F = 12.841$, $p \leq 0.000$) (Table 4). We can see that the year factor had a very significant influence ($F = 13.451$, $p \leq 0.000$), followed by variety factor ($F = 1.539$, $p \leq 0.000$) also had very significant influence. In this case the interaction of the two factors (variety x year) had a very significant influence on this character ($F = 18.186$, $p \leq 0.000$).

The anthocyanins are the compounds that give color of red and rose wine. Their presence in red wines is the predominant form of monoglucose and in very small amounts in the form of diglucose. Wines anthocyanin content is highly variable, depending on the variety of vine and technology used in winemaking: 200-900 mg/L (Țârdea et al 2000).

The Cabernet Sauvignon variety recorded the highest concentration of anthocyanins (727.33±5.03 g/L, 2015), followed by Fetească Neagră variety (617.33±2.43 g/L, 2015) and Merlot variety (429.67±4.51 g/L, 2015). The lowest concentration of anthocyanins was registered in the Cabernet Sauvignon variety (367.33±2.52 g/L, 2014) followed by Merlot variety (302.67±2.08 g/L, 2013) and Fetească Neagră variety (281.33±1.53 g/L, 2013). The difference between the varieties was statistical assured, between variants is a highly significant difference ($F = 10255.032$, $p \leq 0.000$) (Table 4).

Table 4

Analysis of the main quality parameters of the wine obtained at Dealu Bujorului Vineyard

Area	*Variety*	*Year*	*Studied parameter*						
			Total polyphenols (g/L)	*Coloring intensity (420+520 +620 nm)*	*Color tint (420/520 nm)*	*Anthocyanins (mg/L)*	*L-Lactic acid (g/L)*	*Cu (mg/L)*	*Taste qualifying*
Dealu Bujorului	Merlot	2013	$1.29\pm0.01^{e}\ \beta$	$8.74\pm0.06^{c}\ \alpha$	$0.81\pm0.04^{a}\ \alpha$	$302.67\pm2.08^{f}\ \beta$	$0.05\pm0.02^{bc}\ \beta$	SLD	91.00±1.00
		2014	$1.20\pm0.02^{ef}\ \beta$	$7.48\pm0.05^{h}\ \gamma$	$0.68\pm0.02^{d}\ \gamma$	$294.33\pm1.53^{g}\ \gamma$	$0.09\pm0.03^{b}\ \alpha$	SLD	90.00±2.00
		2015	$1.90\pm0.14^{c}\ \alpha$	$8.48\pm0.08^{d}\ \beta$	$0.74\pm0.01^{c}\ \beta$	$429.67\pm4.51^{c}\ \alpha$	$0.05\pm0.04^{bc}\ \beta$	SLD	94.00±1.00
		Avg.[1]	1.25±0.05	8.23±0.06	0.74±0.01	342.22±2.70	0.06±0.03	SLD	91.66±1.33
	Cabernet Sauvignon	2013	$1.14\pm0.02^{f}\ \gamma$	$7.70\pm0.03^{g}\ \gamma$	$0.69\pm0.02^{d}\ \gamma$	$216.33\pm1.53^{i}\ \gamma$	$0.21\pm0.03^{a}\ \alpha$	SLD	94.00±1.00
		2014	$1.33\pm0.02^{e}\ \beta$	$7.91\pm0.14^{f}\ \beta$	$0.72\pm0.02^{c}\ \beta$	$367.33\pm2.52^{e}\ \beta$	$0.22\pm0.03^{a}\ \alpha$	SLD	91.00±4.00
		2015	$2.33\pm0.15^{a}\ \alpha$	$9.05\pm0.05^{b}\ \alpha$	$0.78\pm0.02^{ab}\ \alpha$	$727.33\pm5.03^{a}\ \alpha$	$0.17\pm0.02^{a}\ \alpha$	SLD	94.00±1.00
		Avg.[1]	1.60±0.06	8.22±0.07	0.73±0.02	436.99±3.02	0.20±0.02	SLD	93.00±2.00
	Feteasca Neagră	2013	$1.28\pm0.01^{e}\ \gamma$	$8.38\pm0.09^{de}\ \beta$	$0.74\pm0.02^{c}\ \alpha$	$281.33\pm1.53^{h}\ \gamma$	$0.08\pm0.02^{b}\ \alpha$	-	95.00±1.00
		2014	$1.47\pm0.03^{d}\ \beta$	$8.27\pm0.03^{e}\ \beta$	$0.73\pm0.03^{c}\ \alpha$	$388.29\pm2.08^{d}\ \beta$	$0.08\pm0.02^{b}\ \alpha$	-	91.00±1.00
		2015	$2.10\pm0.10^{b}\ \alpha$	$9.54\pm0.05^{a}\ \alpha$	$0.76\pm0.01^{bc}\ \alpha$	$617.33\pm2.43^{b}\ \alpha$	$0.02\pm0.01^{c}\ \beta$	-	96.00±1.00
		Avg.[1]	1.61±0.04	8.73±0.05	0.74±0.02	428.98±2.01	0.06±0.01	-	94.00±1.00
Avg.[2]			1.48±0.05	8.39±0.06	0.73±0.01	402.73±2.57	0.10±0.02	-	92.88±1.44
F (Fisher factor)			114.947	260.920	12.841	10255.032	26.219	-	-
Sig.			$p \leq 0.000$	$p \leq 0.000$	$p \leq 0.000$	$p \leq 0.000$	$p \leq 0.000$	-	-
Variety		F	12.727	155.255	1.539	3024.221	92.856	-	-
		Sig.	***	***	ns	***	***	-	-
Year		F	415.783	609.315	13.451	31128.410	9.431	-	-
		Sig.	***	***	***	***	**	-	-
Variety x Year		F	15.640	139.556	18.186	3433.748	1.293	-	-
		Sig.	***	***	***	***	ns	-	-

Average values, ± standard deviation (n=3). Romans represent the significance of the variety difference ($p \leq 0.05$). Greeks represent the significance of the same variety cultivated in other year's difference ($p \leq 0.05$). The difference between any two values, followed by a common letter is insignificant.

AVG.[1] = the average of all variants analyzed;

AVG.[2] = the average of variants depending on the year;

Cu = copper.

We can see that the year factor had a very significant influence (F = 31128.410, p≤0.000), followed by variety factor (F = 3024.221, p≤0.000) which also had a very significant influence. In this case the interaction of the two factors (variety x year) had a very significant influence on this character (F = 3433.748, p≤0.000).

The lactic acid is considered as a natural component of wine, since it is formed as a byproduct during alcoholic fermentation. Yeasts transform only 0.05% of sugar (glucose) in the lactic acid, which does not exceed 0.4 g/L, and only a part of the resulting pyruvic acid during the fermentation is converted in to lactic acid (Țârdea 2007). Yeasts form D (-) lactic acid while LDH enzyme form L (+) lactic acid (Țârdea 2007).

Regarding the L lactic acid content of the tested wines, based on the results, we can state that the highest L lactic acid content was recorded in the Cabernet Sauvignon variety (0.21±0.03 g/L, 2013; 0.22±0.03 g/L, 2014; 0.17±0.02 g/L, 2015) these variants are equal in statistical terms. The lowest of the L lactic acid was recorded in Merlot variety (0.05±0.02 g/L, 2013) and Fetească Neagră variety (0.02±0.01 g/L, 2015). It can also be seen that between the studied variants, the differences were significant (F = 26.219, p≤0.000) (Table 4).

We can see that the variety factor had a very significant influence (F = 92.856, p≤0.000), followed by year factor (F = 9.431, p≤0.000) also had very significant influence. In this case the interaction of the two factors (variety x year) it had no influence on this character (F = 1.293, p = 0.310).

Organoleptic analysis of red wines obtained outlines high sensory characters in the years 2013, 2014 and 2015. In terms of quality Merlot wine is delicate, with fruit, softer, intensely colored and low acidy than Cabernet Sauvignon. Ruby red Merlot suggests olfactory flavor of fresh raspberries. Merlot wine is less harsh, it can be put into consumption faster than Cabernet Sauvignon. Merlot variety is poorly resistant to frost and drought also.

Cabernet Sauvignon wine expresses force, virility and strength. It is a wine with intense color, red with shades of purple when is young, intense ruby when over 2 years old, full bodied, extractive, astringent whit a grassy smell taste. Cabernet Sauvignon wine quality reaches its peak after 2-4 years of vessel maturation, and after 3-6 years of bottle maturation.

Feteasca Neagră variety is well colored wine, velvety, harmonious, full bodied has a specific character but with a discreet olfactory smell of prunes when is young and when is older light shades of cinnamon. In good years for viticulture, Feteasca Neagră variety is no less than Cabernet Sauvignon variety. It is however less constant in terms of quality and that is because the grapes is more sensitive to attack by *Botrytis* than Cabernet Sauvignon grapes. Feteasca Neagră variety reaches its peak after 2-3 years old in barrel and 3-8 years in bottle aging.

The highest qualifier of tasting was recorded by Fetească Neagră variety 94.00 followed by Cabernet Sauvignon 93.00 and 91.66 by Merlot variety.

In the case of Cu (mg/L) the concentration of this parameter was below the detection limit of the apparatus and of the used method of analysis.

The tartaric acid is also known as "vinic acid" because it is only formed in the green vine organs (grapes and vine). It is the most abundant and important acid in wine and grapes (60-70%) of the total acids. Starting from the must and up to the bottling of wine, the content of tartaric acid is continuously decreasing. Thus, during the alcoholic fermentation, as the ethyl alcohol is being formed, about 50-60% of the must tartaric acid has been deposited in the form of salts; the precipitation and deposition of potassium tartrate continues (KHT). Kept at cellar temperature, the white wines contain 6-30 mg/L of soluble tartrate and red wines 12-40 mg/L.

The Merlot variety recorded the highest concentration of tartaric acid (1.81±0.03 g/L, 2014), followed by Fetească Neagră (1.76±0.04 g/L, 2014), the lowest concentration of tartaric acid was registered in the Cabernet Sauvignon variety (1.54±0.05 g/L, 2014), followed by Fetească Neagră variety (1.57±0.04 g/L, 2013). The difference between the varieties was statistical assured, between variants is a highly significant difference (F = 20.338, p≤0.000) (Table 5).

Table 5

Analysis of the main quality parameters of the wine obtained at Dealu Bujorului Vineyard

Area	*Variety*	*Year*	*Studied parameter*							
			Tartaric acid (g/L)	*L-Malic acid (g/L)*	*D-Gluconic acid (g/L)*	*Acetic acid (g/L)*	*Alfa-amino nitrogen (mg/L)*	*Iron (mg/L)*	*Potassium (mg/L)*	*Calcium (mg/L)*
Dealu Bujorului	Merlot	2013	1.63±0.03^{cd} γ	ULD	0.06±0.03^{ab} α	0.45±0.01^{b} β	15.18±0.28^{d} α	0.36±0.04^{f} β	778.67±10.02^{f} α	77.87±2.30^{f} α
		2014	1.81±0.03^{a} α	ULD	0.07±0.02^{a} α	0.38±0.02^{e} γ	14.22±0.24^{e} β	0.38±0.01^{ef} β	893.00±17.35^{e} α	90.57±0.81^{de} α
		2015	1.72±0.03^{b} β	ULD	0.05±0.02^{ab} α	0.59±0.01^{a} α	13.74±0.15^{e} γ	0.46±0.01^{bc} α	878.67±3.51^{de} α	85.47±0.50^{ef} α
		Avg.[1]	1.72±0.03	-	0.06±0.02	0.47 ±0.01	14.38±0.22	0.40±0.02	850.11±10.29	84.63±1.20
	Cabernet Sauvignon	2013	1.54±0.04^{f} γ	ULD	0.04±0.03^{ab} α	0.39±0.03^{de} β	24.63±0.93^{c} γ	0.41±0.01^{cd} γ	987.33±12.01^{cd} γ	115.30±4.05^{a} α
		2014	1.75±0.05^{ab} α	1.00±0.20	0.05±0.02^{ab} α	0.38±0.02^{e} β	29.48±0.74^{b} β	0.43±0.01^{c} β	1101.67±32.53^{b} β	111.37±3.51^{ab} α
		2015	1.63±0.03^{c} β	ULD	0.02±0.01^{b} α	0.43±0.01^{bc} α	35.86±0.74^{a} α	0.50±0.01^{ab} α	1252.67±7.02^{a} α	103.40±1.51^{bc} β
		Avg.[1]	1.64±0.04	0.33±0.06	0.03±0.02	0.40 ±0.02	29.99±0.80	0.44±0.01	1113.89±17.18	110.02±3.02
	Feteasca Neagră	2013	1.57±0.04^{de} γ	1.00±0.10	0.07±0.03^{a} α	0.40±0.03^{cde} β	14.30±0.36^{e} α	0.43±0.02^{c} γ	934.33±12.50^{cd} α	87.33±1.40^{def} α
		2014	1.76±0.04^{ab} α	ULD	0.07±0.03^{a} α	0.42±0.02^{cd} β	13.77±0.21^{e} β	0.49±0.07^{ab} βγ	1065.33±15.01^{bc} α	93.80±1.18^{de} α
		2015	1.65±0.03^{c} β	1.03±0.15	0.05±0.01^{ab} α	0.46±0.01^{b} α	12.52±0.17^{f} γ	0.54±0.01^{a} α	1179.67±6.03^{b} α	98.30±0.66^{cd} α
		Avg.[1]	1.66±0.03	0.67±0.08	0.06±0.02	0.42 ±0.02	13.53±0.24	0.48±0.03	1059.77±11.18	93.14±1.08
Avg.[2]			1.67±0.03	0.33±0.04	0.05±0.02	0.43 ±0.01	19.30±0.42	0.44±0.02	1007.92±12.88	95.93±1.76
F (Fisher Factor)			20.338	-	1.815	48.661	843.766	12.695	16.206	17.361
Sig.			p ≤ 0.000	-	p = 0.140	p ≤ 0.000	p ≤ 0.000	p ≤ 0.000	p ≤ 0.000	p ≤ 0.000
Variety		F	12.646	-	3.954	45.684	2991.001	21.458	44.974	63.115
		Sig.	***	-	*	***	***	***	***	***
Year		F	68.297	-	3.009	96.063	62.631	28.286	15.821	0.182
		Sig.	***	-	ns	***	***	***	***	ns
Variety x Year		F	0.203	-	0.148	26.448	160.716	0.519	2.015	3.073
		Sig.	ns	-	ns	***	***	ns	ns	*

Average values, ± standard deviation (n=3). Romans represent the significance of the variety difference (p≤0.05). Greeks represent the significance of the same variety cultivated in other years difference (p≤0.05). The difference between any two values, followed by a common letter is insignificant.
AVG.[1] = the average of all variants analyzed;
AVG.[2] = the average of variants depending on the year.

We can see that the variety year factor had a very significant influence (F = 68.297, p≤0.000), followed by variety factor (F = 12.646, p≤0.000) also had very significant influence. In this case the interaction of the two factors (variety x year) it has no influence on this character (F = 0.203, p = 0.934).

The malic acid is the most common in nature, being synthesized in the green organs of plants and vine as an intermediate between photosynthesis and cellular respiration. It represents about 70% of the total organic acids in the leaves. Like the tartaric acid, the malic acid is a diacid (diprotic acid), but with only one asymmetric C atom in molecule. Therefore, it may exist in the form of two optically active enantiomers isomers: D (+) malic acid and L (-) malic acid. Malic acid is naturally left-handed (L-malic acid). The high level of malic acid imprints the organoleptic character of the "winy" undeveloped, harsh and acerbic taste. Only by reducing the malic acid concentration, the wine becomes more "rounded" and more enjoyable.

The lowest concentration of L-malic acid (g/L) was recorded in the following varieties: Cabernet Sauvignon (1.00±0.20 g/L, 2014), Fetească Neagră (1.00±0.10 g/L, 2013), and Fetească Neagră (1.03±0.01 g/L, 2015) while the other analyzed variants recorded a content below the limit of detection of the device as well as the method of analysis used.

The gluconic acid does not exceed 300 mg/L in must (Țârdea 2007). In exchange, it is abundant in the Tokayi Aszú grapes 0.5-2.5 g/L. During must alcoholic fermentation, the gluconic acid does not undergo any changes (it is not metabolized by yeasts) and is entirely recovered in wine. It does not affect the wine quality. By EU regulation, the maximum content of gluconic acid allowed in wine is 1 g/L. Beyond this limit, the wines are suspected of gluconic acid addition.

The highest concentration of d-gluconic acid (g/L) was registered in the Merlot variety (0.07±0.02 g/L, 2014), followed by Fetească Neagră variety (0.07±0.03 g/L, 2013) and the same variety (0.07±0.03 g/L, 2014) which, in terms of statistics are equal. In contrast, the lowest concentration was recorded in Cabernet Sauvignon variety (0.02±0.01 g/L, 2015). There are no difference between the varieties (F = 1.815, p = 0.140) (Table 5).

As it is formed in wine, the acetic acid hinders the activity of the yeasts fermentation. On the other hand, the acetic acid has the greatest contribution to the formation of the wine volatile acidity, affecting, thus, the quality of the wine. Although a weak acid, it has a great activity in wine. It imprints the taste of "vinegar" when its concentration exceeds 0.7-1.0 g/L.

The highest concentrations of acetic acid (g/L) were recorded in the Merlot variety (0.59±0.01 g/L, 2015), followed by the same variety (0.45±0.01 g/L, 2013), while Merlot variety (0.38±0.02 g/L, 2014) and Cabernet Sauvignon (0.38±0.02 g/L, 2014) have a lower acetic acid level.

The evolution of assimilable nitrogen in the grapes is closely linked to the vine metabolism. The variations between varieties are determined by the content of the ɑ-amino nitrogen from grapes and less by the ammoniacal nitrogen. During the ripening of grapes the level of assimilable nitrogen increases progressively within relatively limited proportions: the ɑ-amino nitrogen content increases and the content of ammonical nitrogen decreases. Overall the total assimilable nitrogen does not record a significant change. The decrease of the ammoniacal nitrogen in favor of the nitrogen amine corresponds to the nitrate metabolism of the grapes. Overripe grapes do not necessarily provide lower total assimilable nitrogen content, but a lower content of ammonia nitrogen. A content of amino nitrogen of 140 mg/L of must is estimated as limited value to the yeast activity.

The lowest values of the concentration of amino nitrogen were recorded in Fetească Neagră variety (12.52±0.17 mg/L, 2015) and Merlot varieties (14.22±0.24 mg/L, 2014), while Cabernet Sauvignon (35.86±0.74 mg/L, 2015) registered the highest values. The differences between varieties were statistical assured, between variants is a highly significant difference (F = 843.766, p≤0.000).

We can see that the variety factor had a very significant influence (F = 2991.001, p≤0.000), followed by the interaction of the two factors (variety x year) had also a very significant influence on this character ($F = 160.716$, $p \leq 0.000$), and year factor ($F = 62.631$, $p \leq 0.000$) had very significant influence.

By mineral nutrition the grapevines accumulate small amounts of Fe 2-3 mg/L in must. Further enrichment of must with exogenous iron is due to ground debris remaining on the grapes and due to the contact with bare metal parts of the wine machinery, reaching up to 25-30 Fe/L. Due to the reducing environment, during alcoholic fermentation some of the Fe deposits and is removed from wine along with the yeast. As a result, the wine contains low amounts of iron, usually 4-5 mg/L. Most of the iron in wine comes from storing the wine in bare metallic tanks and from the contact with wines conditioning machines (filters, pumps, hoses).

Regarding the iron content of wine, the highest concentration of Fe was recorded in the wines produced from Fetească Neagră variety (0.54±0.01 mg/L, 2015), and Cabernet Sauvignon variety (0.50±0.01 mg/L, 2015). At the opposite, the lowest concentration of Fe was recorded in Merlot (0.36±0.04 mg/L, 2013) and Merlot varieties (0.38±0.01 mg/L, 2015). The differences between the varieties were statistical assured, between variants is a highly significant difference ($F = 12.695$, $p \leq 0.000$).

In a normal state, the wine contains 0.4-1.5 g K/L, particularly in the form of KHT (bitartrate) (Țârdea 2007). In a free state, the amounts of potassium are lower, for example, the Chardonnay wines from the Murfatlar Vineyard contain 410-496 mg K/L, while the Sauvignon 640-710 mg K/L (Marin et al 1996); the red wines from Uricani-Iași contain 680-1125 mg K/L (Țârdea 2007). The increasing of wine concentration of potassium is due to the use of chemical potassium fertilizers, irrigation and to the addition of potassium metabisulfite in the wine that can reach up to 3.5-7.0 g of potassium bitartrate/L of wine (Ţârdea 2007).

Based on the presented data it can be seen that potassium is found in high concentrations in wine. The highest concentration of K was recorded in the Cabernet Sauvignon variety (1,252.67±7.02 mg/L, 2015), followed by the same variety (1,101.67±32.53 mg/L, 2014); to the opposite are the varieties of Merlot (778.67±10.02 mg/L, 2013 and 893.00±17.35 mg/L, 2014). It can be stated that the tested varieties of vines had a high influence on the accumulation of K in wine. The differences were statistically displayed ($F = 16.206$, $p \leq 0.000$). The concentration of this element is within normal limits compared with the national and international data.

Calcium is a natural component of wine. It accumulates in the grapes until the ripening. The amounts are low, only 50-200 mg Ca^{2+}/L of must. Wine always contains less calcium than the must it comes from, because alcohol contributes to the insolubilization of calcium tartrate. White wines have a higher level in calcium than red wines and are prone to forming tartaric deposits (Țârdea 2007). For example, the red wines of Uricani-Iași have a calcium content of 56-88 mg/L, and the white wines of Bucium-Iaşi 78-98 mg/L (Odăgeriu 2004). Generally, white wines have a 20-30% higher content of calcium than red wines (Ţârdea 2007).

Regarding the calcium concentration in wine, the varieties Cabernet Sauvignon (115.30±4.05 mg/L, 2013) followed by the same variety (111.37±3.51 mg/L, 2014) reached the highest concentration compared to the varieties of Merlot (85.47±0.50 mg/L, 2015 and 77.87±2.30 mg/L, 2013) which recorded the lowest concentration.

The Person correlation between the main parameters analyzed. In order to determine whether the main quality parameters of wine can influence each other, the Person correlation coefficient was calculated for each studied parameter: alcohol (Acl.), volatile acidity (Aciv.), total SO_2 (St.), sugar (Sug.), non-reducing extract (NRextr.), glycerol (G.); total polyphenols (TPoly.), coloring intensity (CI.), color tint (CT.), anthocyanin (Antho.), L-lactic acid (AciL-L.), acetic acid (Acia.), amine nitrogen (Aami.), iron (Fe), potassium (K), calcium (Ca) (Table 6).

A Person correlation coefficient value greater than 0.5 shows a strong correlation between the analyzed varieties, a positive correlation between the two parameters show that both parameters increase, and a negative correlation indicates that a parameter increases while the second one decreases and vice versa.

Table 6

Person correlation matrix between the main analyzed wine parameters

	Acl.	*Aciv.*	*St.*	*Sug.*	*NRextr.*	*G.*	*TPoly.*	*CI.*	*CT.*	*Antho.*	*AciL-L.*	*Acia.*	*Aami.*	*Fe*	*K*	*Ca*
Acl.	**1.000**	0.253	-0.639**	0.290	0.572**	0.552**	0.341	0.270	-0.061	0.419*	0.179	0.018	-0.164	0.541**	0.361	0.129
Aciv.	0.253	**1.000**	-0.484*	-0.595**	-0.121	0.050	0.434*	0.129	-0.068	0.287	0.056	0.596**	0.151	0.197	-0.003	0.174
St.	-0.639**	-0.484*	**1.000**	0.177	-0.151	-0.406*	-0.345	0.050	0.420*	-0.322	-0.039	-0.100	-0.009	-0.428*	-0.270	-0.152
Sug.	0.290	-0.595**	0.177	**1.000**	0.172	0.177	-0.549**	-0387	-0.151	-0.387*	0.132	-0.553**	0.184	-0.202	-0.055	0.064
NRextr.	0.572**	-0.121	-0.151	0.172	**1.000**	0.680**	0.688**	0.645**	0.428*	0.796**	-0.146	0.089	0.018	0.724**	0.688**	0.080
G.	0.552**	0.050	-0.406*	0.177	0.680**	**1.000**	0.466*	0.149	-0.127	0.492**	-0.048	0.184	0.252	0.672**	0.509**	0.089
TPoly.	0.341	0.434**	-0.354	-0.549**	0.688**	0.466*	**1.000**	0.777**	0.453*	0.954**	-0.210	0.514**	-0.046	0.741**	0.592**	0.008
CI.	0.270	0.129	0.050	-0.387*	0.645**	0.149	0.777**	**1.000**	0.741**	0.765**	-0.465*	0.419*	0.028	0.607**	0.426*	-0.150
CT.	-0.061	-0.068	-0.420*	-0.151	0.428*	-0.127	0.453*	0.741**	**1.000**	0.464*	-0.389*	0.315	0.355	0.204	0.132	-0.304
Antho.	0.419*	0.287	-0.322	-0.387*	0.796**	0.492**	0.954**	0.765**	0.464*	**1.000**	-0.112	0.293	0.816**	0.737**	0.698**	0.083
AciL-L.	-0.179	0.056	-0.039	0.132	-0.146	-0.048	-0.210	-0.465**	-0.389*	-0.112	**1.000**	-0.483*	-0.177	-0.077	0.364	0.789**
Acia.	0.018	-0.596**	-0.100	0.553**	0.089	0.184	0.514**	0.419*	0.315	0.293	-0.483*	**1.000**	-0.524**	0.053	-0.074	-0.248
Aami.	-0.164	0.151	-0.009	-0.117	0.184	0.018	0.252	-0.046	0.028	0.355	0.816**	-0.300	**1.000**	-0.083	-0.229	-0.388*
Fe	-0.541**	0.197	-0.428*	-0.202	0.724**	0.672**	0.741**	0.607**	0.204	0.737**	-0.077	0.242	0.130	**1.000**	-0.193	0.293
K	0.361	-0.003	-0.270	-0.055	0.688**	0.509**	0.592**	0.426*	0.132	0.698**	0.364	-0.193	0.584**	0.789**	**1.000**	0.651**
Ca	0.129	0.174	-0.152	0.064	0.080	0.089	0.008	-0.150	-0.304	0.083	0.789**	-0.388*	0.693**	0.293	0.651**	**1.000**

Acl. = alcohol (% vol.); Aciv. = volatile acidity (g/L CH_3COOH); St. = total SO_2 (mg/L); Sug. = sugar (mg/L); NRextr. = non-reducing extract (g/L); G. = glycerol (g/L); Tpoly. = total polyphenols (g/L); CI. = coloring intensity; CT. = color tint; Antho. = anthocyanin (mg/L); AciL-L. = L-lactic Acid (g/L); Acia. = acetic acid (g/L); Aami. = amino nitrogen (mg/L); Fe = Iron (mg/L); K = potassium (mg/L); Ca = calcium (mg/L).
*the correlation is significant at $p<0.05$ in 95%; ** the correlation is highly significant at $p < 0.01$, in 99%; N = 27.

The obtained results exhibit a large number of both positive and negative correlations between the main parameters of the analyzed wine (alcohol (Acl.) & SO_2 total (St.) (r^2 = -0.639 **); (Alcool (Acl.) & non-reducing extract (NRextr.) (r^2 = 0.572 **); (alcohol (Acl.) & glycerol (G.) (r^2 = 0.552 **); (alcohol (Acl.) & anthocyanins (Antho.) (r^2 = 0.419 *); (alcohol (Acl.) & Iron (Fe) (r^2 = -0.541 **); volatile acidity (Aciv.) & SO_2 total (St.) (r^2 = -0.484 *); volatile acidity (Aciv.) & sugar (Sug.) (r^2 = -0.595 **); volatile acidity (Aciv.) & total polyphenols (Tpoly.) (r^2 = 0.434 *); volatile acidity (Aciv.) & acetic acid (Acia.) (r^2 = -0.596 **); SO_2 total (St.) & glycerol (G.) (r^2 = -0.406 *); SO_2 total (St.) & color tint (CT.) (r^2 = -0.420 *); SO_2 total (St.) & Iron (Fe) (r^2 = -0.428 *); sugar (Sug.) & total polyphenols (Tpoly.) (r^2 = -0.549**); sugar (Sug.) & anthocyanins (Antho.) (r^2 = -0.387 *); sugar (Sug.) & acetic acid (Acia.) (r^2 = 0.553 **); non-reducing extract (NRextr.) & glycerol (G.) (r^2 = 0.680 **); non-reducing extract (NRextr.) & total polyphenols (Tpoly.) (r^2 = 0.688 **); non-reducing extract (NRextr.) & coloring intensity (CI) (r^2 = 0.645 **); non-reducing extract (NRextr.) & color tint (CT) (r^2 = 0.428 *); non-reducing extract (NRextr.) & anthocyanins (Antho.) (r^2 = 0.796 **); non-reducing extract (NRextr.) & iron (Fe) (r^2 = 0.724 **); non-reducing extract (NRextr.) & potassium (K) (r^2 = 0.688 **); glycerol (G.) & total polyphenols (Tpoly.) (r^2 = 0.466 **); glycerol (G.) & anthocyanins (Antho.) (r^2 = 0.492 **); glycerol (G.) & iron (Fe) (r^2 = 0.672 **); glycerol (G.) & potassium (K) (r^2 = 0.509 **); total polyphenols (Tpoly.) & coloring intensity (CI) (r^2 = 0.777 **); total polyphenols (Tpoly.) & color tint (CT) (r^2 = 0.453 *); total polyphenols (Tpoly.) & anthocyanins (Antho.) (r^2 = 0.954 **); total polyphenols (Tpoly.) & acetic acid (Acia.) (r^2 = 0.514 **); total polyphenols (Tpoly.) & iron (Fe) (r^2 = 0.741 **); total polyphenols (Tpoly.) & potassium (K) (r^2 = 0.592 **); coloring intensity (CI) & color tint (CT) (r^2 = 0.741 **); coloring intensity (CI) & anthocyanins (Antho.) (r^2 = 0.765 **); coloring intensity (CI) & L-lactic acid (aciL-L) (r^2 = -0.465 **); coloring intensity (CI) & acetic acid (Acia.) (r^2 = 0.419 *); coloring intensity (CI) & iron (Fe) (r^2 = -0.607 **); coloring intensity (CI) & potassium (K) (r^2 = 0.426 *); color tint (CT) & anthocyanins (Antho.) (r^2 = 0.464 *); color tint (CT) & L-lactic acid (aciL-L) (r^2 = -0.389 **); anthocyanins (Antho.) & iron (Fe) (r^2 = 0.737 **); anthocyanins (Antho.) & potassium (K) (r^2 = 0.698 **); L-lactic acid (aciL-L) & Acetic Acid (Acia.) (r^2 = -0.483 **); L-lactic acid (aciL-L) & Amine Nitrogen (Aami.) (r^2 = 0.816 **); L-lactic acid (aciL-L) & calcium (Ca) (r^2 = 0.789 **); acetic acid (Acia.) & calcium (Ca) (r^2 = 0.388 *); Amine Nitrogen (Aami.) & potassium (K) (r^2 = 0.584 **); Amine Nitrogen (Aami.) & calcium (Ca) (r^2 = 0.693 **); iron (Fe) & potassium (K) (r^2 = 0.789 **); potassium (K) & calcium (Ca) (r^2 = 0.651 **) (Table 6).

Based on the Person correlation index, in the present research can be stated that the main parameters analyzed from wine have influenced each other, in other words, the quality of the wine produced at Dealu Bujorului Vineyard is directly contingent on all these parameters.

Conclusions. The ecoclimatic conditions studied in the Dealu Bujorului, Bujoru Wine Centre, highlighted the exceptional viticultural character of Romania as well as the authenticity character encountered in the large variety of wines produced in the studied areas. Based on the results regarding the qualitative assessment of the three varieties under testing, can be observed that the varieties have a very good suitability in the studied areas and in terms of quality rating, they display the variety particular character, as well as the eco climatic conditions and ecopedological influence on the quality of wine. The Person correlation index revealed the presence of a close link between the main quality parameters of wine. Results also show that the vine varieties cultivated at the vineyard of Dealu Bujorului have a high content of macroelements (Merlot, Cabernet Sauvignon and Feteasca Neagră) that are very important for human health. Copper content is below the limit of detection due to the modern technology for obtaining wines in a controlled manner. This paper gives us new information on the quality of white wines obtained at Dealu Bujorului, Romania for their promotion and marketing.

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