RESEARCH REGARDING THE PHENOLIC MATURITY OF THE FETEASCA NEAGRA AND MERLOT VARIETIES FROM DEALU BUJORULUI VINEYARD

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Abstract. Phenolic compounds, extractable from grape skins and seeds, have a notable influence on the sensorial properties of red wines, especially their chromatic characteristics, bitterness and astringency. The phenolic compounds, together with the aroma precursors are the main factors that affect wine quality. Consequently, they have been studied extensively in grapes and wine. The purpose of this research was to accurately determine ecoclimatic conditions of 2017 from Dealu Bujoru and also to determine the phenolic maturity of Feteasca Neagra and Merlot from Dealu Bujorului vineyard. Under the ecoclimatic conditions of 2017, the grapes entered in the ripening process prematurely, and full maturity was very early. The dynamics accumulation of the sugars and color compounds until the harvest was alert. The results showed the suitability of ecoclimatic conditions and the proper growth and development of the tested varieties for obtaining wines with superior's quality.

Keywords: authenticity, grapevine, wine analysis

INTRODUCTION

For years, scientists have commented on the longevity of the French, despite their fat diet, higher calorie and heavily salted food. It has been found that, the daily intake of red wine seems to be a protecting constituents of the French diet. A large number of scientific reports have presented epidemiological data supporting the notion those who consume alcoholic beverages in moderation are at lower risk of mortality and morbidity from coronary heart disease (CHD) than abstainers (Kannel and Ellison, 1996).

The most popular food product produced from grapes is wine. Wine is also the most popular alcoholic beverage throughout the world. The significance of geographical origin to wine is greater than in any other food product – terroir. The terroir is the natural locality of each plant of grapevine in a vineyard. Each terroir is influenced by geological, climatic and soil factors, and also by human activity when treating the vineyard. Each grape produced in a specific terroir reflects the locality in its chemical composition. Wine is also among food products that are very often subject to falsification in terms of variety or geographical origin. The terms of authenticity and traceability are therefore very important for wine producers and consumers alike.

The idea of wine authenticity evaluation on the basis of geographical origin is also recommended by Charlton et al., (2010), who stated that the chemical composition was able to give a perfect indication of wine origin but only if the origin was significant with a higher level of specification that the individual geographical localities. The best determination of the origin of origin is possible on the basis of the analytical profile of wine. Phenolic compounds can be used as chemical markers to confirm the authenticity of wine based on the geographical origin (Fanzome et al., 2010).

Phenolic synthesis is part of a coordinated suite of changes that accompanies berry ripening. Environmental factors include all external stimuli, the most influential of which for phenolic synthesis are light and temperatures, as well as others such as water status, nutritional and pathogenesis status. These factors modulate grapevine physiology and may influence vine vigour, crop load, as well as the balance between photosynthetic carbon fixations and partitioning of assimilates to ripening berries (Castellarin et al., 2012). Ali et al., (2010) mentioned that phenolic compounds mostly come from grape berries and some of them originated in chemical and biochemical reactions during the winemaking process. Thus the composition and the content of phenolic compounds mostly depend on the individual vineyard.

Red wine is one of the beverages that offers a dual action of alcohol and an antioxidant. The active constituents in red wine are the polyphenols. The phenolic components of red wine have been widely implicated as the reason for this advantage because they are at least on order of magnitude lower in white wine and virtually absent from all other alcoholic beverages (Ghiselli et al., 1998). „Plant phenolics" and „polyphenols" are secondary natural metabolites arising biogenetically from either the shikimate/phenylpropanoid pathway, which directly provides phenolypropanoids, or the „polyketide" acetate/malonate pathway, which can produce simple phenols, or both, thus producing monomeric and polymeric phenols and polyphenols, which fulfill a very broad range of physiological roles in plants. Higher plants synthesize several known different phenolic compounds. The ability to synthesize phenolic compounds gas been selected throughout the course of evaluation in different plant lineages, thus permitting plants to cope with the constantly changing environmental challenges over evolutionary time (Lattanzio, 2013). Wine phenolics belong to two main groups of compounds, nonfavonoids (hydroxybenzoic and hydroxycinnamic acids and their derivatives, stilbenes and phenolic alcohols) and flavonoids (anthocyanins, flavanols, flavonols and dihydroflavonols).

Hydroxycinnamic acid compounds (caffeic acid) occur most frequently as simple ester with hydroxyl carboxylic acids or glucose, while the hydroxybenzoic acid compounds (gallic acid) are present mainly in the form of glucosides. Flavonoids are a subclass of polyphenols, widely distributed in nature. As a results, specific groups of foods are often rich sources of one or more subclasses of these polyphenols. Catechins (or flavonols) is a category of the flavonoids. Research shows that the grape is rich in specific antioxidants, with the basic structure of catechins and epicatechin. Flavonols also include quercetin, while resveratrol is a stilbene, other group of flavonoid. It is a polyphenol which has been in the news a great deal for potential anti-cancer and anti-aging benefits (Tarola et al., 2007).

Several studies have shown that a group of polyphenol antioxidant compounds found in wine and grapes may lower the risk of a range of cancers, but exactly how these powerful compounds work has remained unclear. Polyphenols exhibit a wide spectrum of biochemical activities. Among them, their free radical scavenging activities and their abilities to chelate certain pro-oxidant metals are most noble. Most polyphenols have anticarcinogenic, anti-inflammatory properties and antimicrobial activity. A high intake of polyphenols is likely to have beneficial effects on the cardiovascular system. As we absorb polyphenols, they change the properties of blood lipids making LDL-cholesterol more resistant to the sort of oxidation that can trigger atherosclerosis and coronary heart disease (Tarola et al., 2007).

The aim of our research was therefore to (i) establishment the ecoclimatic conditions from Dealu Bujorului vineyard 2017 year of culture, and (2) determination of phenolic maturity of the Feteasca Neagra and Merlot varieties.

MATERIAL AND METHODS

Ecoclimatic conditions from Dealu Bujorului vineyard. The weather data used in this research was recorded at the weather forecasting center and also to the AgroExpert system of RSVE Bujoru. Based on this data some climatic indicators for the growth and fructification of the grapevine were determined as follow: global thermal balance (Σt°g) are the sum of all positive daily temperature from active period; active thermal balance (Σt°a) are the sum of all daily mean temperature ≤ 10 °C; beneficial thermal balance (Σt°u) are the sum of all daily mean temperature above < 10 °C; thermal coefficient (C_t); amount of monthly and annual precipitation; amount of hours with sun (Σir) and real insolation coefficient (Ci). Ct is given by ration of the overall balance (Σt°g) and number of days from the active period; Ci is given by the ration between the hours with sun and the growing season days. Cp is given by the ration between the rainfall from the growing season (mm) and the number of days of the growing season (Bora et al., 2016). In order to get a clearer image about how ecoclimatic conditions influence the growth and fructification of grapevine, some interactions of climatic factors were calculated: the real Heliothermal index (HI_r), the hydrothermal coefficient (CH), the bioclimatic vineyard index (I_{bv}), annual aridity index Martonne ($I_{ar\text{-}DM}$), the Huglin index (HI), oenoclimatic skills index (IAO_e) and cooling night index (CI). The method after these interactions between ecoclimatic factors were calculated was optimized in a previous work (Bora et al., 2018).

Phenolic maturity of the red wine varieties from Dealu Bujorului vineyard

Raw material. Different grape (*Vitis vinifera*) varieties Merlot (M) and Feteasca Neagra (FN) from different vineyard parcels were studied over six weeks (from August to September) to monitor phenolic and technological maturity over harvest time in conditions of 2017. For each sampling 1.200 grape berries were randomly picked with pedicels attached. Vine varieties were collected at different times during ripening: A (13 VIII), B (20 VII), C (27 VII), D (03 IX), E (10 IX), F (17 IX) and also with different pruning system AA (28 buds), BB (20 buds) and CC (36 buds). To establish grape maturity index or achieved the following analysis: the weight of 100 berries (g), pH, total acidity (g/L H_2SO_4), sugar content (g/L), total anthocyanins potential (mg/L), anthocyanin extractability (AE), percentage of extractable anthocyanins (PEA %), total phenolic richness (RPT %), total content of tannins in skin (ST), total content of tannins in seeds (ST) and maturity of seeds (MP %). The method after which it was established grape maturity index was optimized in a previous work (Bora et al., 2018).

Statistical analysis. The statistical interpretation of the results was performed using the DUNCAN test, using the SPSS, version 24 (SPPS Inc. Chicago, IL, USA). The statistical processing of the results was primarily made to calculate the following statistical parameters: arithmetic average, standard deviation, average error, using the SPSS version 24 (SPPS Inc. Chicago, IL, USA).

RESULTS AND DISCUSSIONS

Study of ecoclimatic conditions. The duration of the growing season is within its normal limits over 170 days for the culture of vine (Bora et al., 2016), but in 2017 this limit was exceeded: were recorded 183 days for Dealu Bujorului Vineyard, Bujoru Wine Centre. Comparing these values (183 days) with the multiannual average (187.3 days) it can be observe a decrease of the vegetation period.

In this experimental year of 2017 the thermal balance values obtained are much lower than multiannual average: global thermal balance (Σt°g) was 3304.1°C, useful thermal balance (Σt°a) was 3174.8°C and active thermal balance (Σt°a) was 3174.8°C.

Regarding the number of days with a maximum temperature of over 30°C, in 2017 year was a 30.3 days, there is an decrease comparing these values to multiannual average 33.5 days. The precipitation quantity in 2017 was highest (553.9 mm) then average of the last ten years (505.7 mm). During the growing season, the recorded precipitations values were 305.9 mm, much highest than the multiannual average of 286.4 mm for Bujoru Wine Centre.

The insolation measured by number of hours of sunshine was higher than normal in the months during the growing season, 1503.6 hours over the normal of 1441.0 hours (multiannual average). Insolation coefficient (C_i) recorded value of 8.20 this shows an increase compared to the multiannual average (7.69).

In the climatic conditions of 2017, the real Heliothermal index (HIr) values were 2.40 falling within the limits describe in the scientific literature (1.35 and 2.70), which shows an increase in the heliothermal resources and optimal conditions for the ripening of late maturing variety (Bora et al., 2016). Comparing with the multiannual average (2.49) it can be observed that in 2017 this parameter shows an increase.

The hydrothermal coefficient (CH) it was higher 0.96 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 table and wine grapes varieties. The viticultural bioclimatic index (Ibcv) with a value 8.53 for 2017 shows the heliothermal resources recorded high values due to low hydrous resources for Bujoru wine center (multiannual average 10.34).

The Oenoclimatic suitability (IAOe) had a value of 4622.5 indicating an area with favorable conditions for growth of red varieties for wine, and also for the white wines. The Martonne aridity index had a value of 26.6 during the growing season, indicating a semiarid forest steppe climate. The heliothermal Huglin index provide useful information regarding the thermal potential for the culture of grape, 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 2095 (multiannual average was 2332.4). The cooling night index (CI) was calculated only for September and the obtained value was 9.9, value that was lower that multiannual average 10.54.

The ecoclimatic conditions of Dealu Bujorului vineyard highlighted the exceptional viticultural characters of the Dealu Bujorului vineyard. These characters were found in the authenticity and specificity of a wide assortment of wine obtained in the studied area. In this context it was expected that, in qualitative terms, the two varieties tested until now present a good adaptability and therefore the results of the phenolic maturity indicate the production of quality wines.

Phenolic maturity of red wine varieties in Dealu Bujorului vineyard

Regarding weight of 100 berries (g), the highest values were recorded by Merlot variety [135.75±0.64 g (28 buds) (27.VIII)]; [130.30±0.81 g (36 buds) (13.VIII)]; and [125.09±0.39 g (28 buds) (13.VIII)].

The lowest values have been recorded by Merlot variety in all three form of culture system in 17.IX [101.33±0.11 (28 buds); 106.22±0.09 (20 buds); 103.39±0.14 (36 buds)].

Table 1.

Ecoclimatic conditions in Dealu Bujorului

Area	Climate conditions		Multiannual 2007-2016	Specific values 2017	Extreme values Min.	Extreme values Max.	Vine breakpoints
Bujoru Vineyard	The vegetation period	Days	187.3	183	177	198	150-170
	Thermal balance (°C)	Global ($\Sigma t^0 g$)	3520.8	3304.1	3067.4	3781.5	2700-3600
		Active ($\Sigma t^0 a$)	3431.8	3174.8	2949.1	3871.0	2600-3500
		Beneficial ($\Sigma t^0 u$)	1725.8	1601.5	1578.3	2031.5	1000-1700
		Thermic Coefficient (C_t)	18.4	17.3	15.6	20.6	16-19
		Minimum absolute air temp.	-19.0	-18.9	-25.0	-17.3	-
		Maximum absolute temp.	37.1	37.5	34.2	41.5	-
		Avg. max. temp. August	33.5	30.3	34.8	41.5	-
		Avg. temp. decade I and II June	22	21	18.0	24.6	-
		No. of days max temp. > 30	48.3	45.0	27.0	66.0	-
	Insolation (hours)	Real (∑ir)	1718.8	1900.2	1679.1	2094.6	1200-1600
		∑ hours of insolation in the growing season (mm)	1441.0	1503.6	1357.9	1535.8	-
		Insolation Coefficient (C_i)	7.69	8.20	7.18	8.30	7-9
	Precipitations (mm)	∑ precipitations in the growing season	286.4	305.9	218.2	516.0	-
		Annual (∑pp)	505.7	553.9	344.1	713.1	500-700
		Precipitation Coefficient (Cp)	1.52	1.67	0.94	2.62	0.9-2.7
	Interaction of climate factors	Real Heliothermal index(HI_r)	2.49	2.40	2.03	3.12	1.35-2.70
		Hydrothermal coefficient (CH)	0.85	0.96	0.49	1.57	0.6-1.8
		Bioclimatic vineyard index (I_{bcv})	10.34	8.53	5.09	17.00	4-15
		Oenoclimatic skills index (IAOe)	4838.1	4622.5	4141.4	5344.3	-
		Annual aridity index Martonne (I_{ar-DM})	22.6	26.6	15.9	33.79	-
		Heliothermal Huglin index (HI) in the growing season	2332.4	2095.0	2095.0	2880.9	-
		Cooling nights index (CI)	10.54	9.90	9.30	13.60	-

Among the variants analyzed there are very significant differences (F = 562.365; *p ≤ 0.000*). It can be seen that in this case data of sampling (F = 24.187; *p ≤ 0.000*) but also the interaction between data of sampling and culture system (F = 14.052; *p ≤ 0.000*) had a very significant influence on the weight of 100 berries. While culture system (F = 3.025; *p ≤ 0.037*) has a significant influence on this parameter.

pH shows values between 3.11 and 3.56 with an average value of 3.23. The highest values were recorded by Merlot variety [3.56±0.28 (28 buds) (03.IX)] and Feteasca Neagra variety [3.41±0.03 (28 buds)(27.VIII)]; [3.42±0.05 (20 buds)(27.VIII)]; [3.46±0.08 (36 buds)(27.VIII)]. The lowest values were recorded by Feteasca Neagra variety [3.15±0.04 (28 buds)(13.VIII)]; [3.13±0.04 (20 buds)(13.VIII)]; [3.11±0.05 (36 buds)(13.VIII)] and Merlot variety [2.96±0.04 (28 buds)(13.VIII)]; [3.11±0.12 (20 buds)(13.VIII)]; [2.96±0.12 (36 buds)(13.VIII)].

Physiologically the acid sensation of wine is exerted by free hydrogen ions and increases with their concentration [H^+]. Acid sensation persists in the oral cavity because wine is a strong buffered solution and opposes the acid neutralization action of salivary alkalinity. All organic acids in wine act in the same way on acid sensation, at same values and buffering power. The only acid that distinguishes itself from other acids is lactic acid, its presence in wine being perceives only by taste (Bora et al., 2018). Concerning total acidity (g/L H_2SO_4) Feteasca Neagra [10.40±0.13 g/L H_2SO_4 (20 buds)(13 VIII); 10.53±0.03 g/L H_2SO_4 (36 buds)(13 VIII)] and Merlot [11.87±0.22g/L H_2SO_4 (20 buds)(13 VIII)] recorded the highest values. A decrease in total acidity can be observed at Merlot variety [5.06±0.03

g/L H_2SO_4 (28 buds)(03 IX); 4.60±0.11 g/L H_2SO_4 (20 buds)(03 IX); 4.42±0.12 g/L H_2SO_4 (36 buds)(03 IX)], that gradual decrease of acidity we observe again at the Merlot variety in 17 IX [4.28±0.01 g/L H_2SO_4 (28 buds); 4.23±0.05 g/L H_2SO_4 (20 buds); 4.32±0.17 g/L H_2SO_4 (36 buds)].

In the beginning, the accumulation of sugar in berries is slow and occurs by mobilizing the starch from the vineyard deposited as reserve substance. Gradually sugar accumulation increases on the photosynthesis process of the leaves. Grape berries act as a receptor, in the sense of increased influx of sugars, also corresponds to a quantity of water to reach an osmotic balance throughout the vine (Bora et al., 2018). The lowest amount of sugar has been recorded in 13.VIII by Feteasca Neagra [160.40±1.95 g/L (28 buds); 171.14±0.99 g/L (20 buds); 160.10±0.90 g/L (36 buds)] and Merlot [171.13±0.18 g/L (28 buds); 143.36±0.81 g/L (20 buds); 162.40±0.43 g/L (36 buds)]. The highest amount of sugar has been recorded in 10.IX by Merlot [263.43±0.13 g/L (28 buds); 256.34±0.24 g/L (20 buds); 261.29±0.18 g/L (36 buds)] and in 17. IX by Merlot variety [301.13±0.17 g/L (28 buds); 287.29±0.36 g/L (20 buds); 299.08±0.05 g/L (36 buds)].

Anthocyanins constitute a very large family of polyphenols in plants and are responsible for many of fruit and floral colours observed in nature (Nile et al., 2014), they are pigments dissolved in the vacuolar sap of the epidermal tissues of flowers and fruit which impart red, pink, blue or purple colours (Mazza et al., 1993). Grapes are among the fruits containing the highest content of phenolic substances, which are partially extracted during the winemaking process and brewing (Revilla et al., 2002; Bora et al., 2018).

Regarding total anthocyanins potential (mg/L), the highest values were recorded by Merlot in 03.IX [2247.11±8.23 mg/ L (20 buds); 2089.22±12.26 mg/L (36 buds)] and also in (27.VIII) by Feteasca Neagra variety [1902.48±15.02 mg/L (36 buds)]. The lowest concentration of total anthocyanins potential was recorded in wine form Merlot variety in (13.VIII) [824.32±4.02 mg/L (20 buds); 810.25±2.01 mg/L (36 buds)]. The difference between the analyzed variants is statistically assured (F = 1147.006; $p \leq 0.000$) between them was significant influence. Based on the polyfactorial analysis we can see that the total anthocyanins potential was significant influence by data of sampling factor (F = 172.058; $p \leq 0.000$), while the rest of the factors did not have any influence on accumulation of total anthocyanins.

Feteasca Neagra in (27.VIII) [648.02±1.02 mg/L (28 buds); 668.85±0.23 mg/L (20 buds); 658.00±2.14 mg/L (36 buds)] and Merlot [661.66±4.18 mg/L (20 buds)] recorded the highest values to extractable anthocyanins potential, compared to Merlot variety in 10. IX [192.36±1.17 mg/L (28 buds); 193.73±1.23 mg/L (20 buds)] and Merlot from 17. IX [123.69±1.25 mg/L (20 buds)], varieties that recorded the lowest values for extractable anthocyanins potential.

In case of extractable anthocyanins potential (PEA) Merlot variety in 10. IX [82.32±0.12 AE% (28 buds); 81.02±1.12 AE% (20 buds)] and in 17. IX [88.58±0.21 AE% (20 buds)] recorded the highest values, compared with Feteasca Neagra in 13. VIII [45.94±1.64 AE% (28 buds); 58.60±0.86 AE% (20 buds); 59.25±0.02 AE% (36 buds)] and Merlot in 13. VIII [67.25±0.07 AE% (28 buds); 65.21±0.08 AE% (20 buds); 62.47±0.26 AE% (36 buds)]. The lower the AE% the higher the degree of extractability of anthocyanins in the grapes, and the wine will be more intensely colored.

The concentration of total phenolic compounds in commercially available red wines is rarely above 2.5 g/L (Singleton et al., 1982). Phenolic compounds have long been considered to be basic components of wines and over 200 compounds have been identified.

Two primary classes of phenolic that occur in grapes and also in wine are flavonoids and nonflavonoids.

Total polyphenols (RPT) is the amount of tannins from skin and tannins from seeds. The highest values of the total polyphenols (RPT) were recorded by Merlot variety in 03. IX [32.96±0.17 total polyphenols (RPT) (10.18±0.18 tannins from skin and 21.97±4.78 tannins from seeds) (20 buds)]; [27.12±1.42 total polyphenols (RPT) (11.44±0.93 tannins from skin and 15.67±1.93 tannins from seeds) (36 buds)]. While Merlot variety from 13. VIII [13.38±0.60 total polyphenols (RPT) (7.32±0.02 tannins from skin and 6.06±0.61 from seeds (28 buds)); 12.51±0.50 total polyphenols (RPT) (6.35±0.04 tannins from skin and 6.16±0.52 tannins from seeds (20 buds)); 12.67±0.61 total polyphenols (RPT) (6.53±0.05 tannins from skin and 6.14±0.57 tannins from seeds) (36 buds)] recorded the lowest values for total polyphenols (RPT).

The maturity of the seeds (%) shows an exponential growth, Feteasca Neagra variety from (13. VIII) [41.42±2.15 (28 buds); 41.40±1.60 (20 buds); 44.18±1.40 (36 buds)] recorded the lowest values while Merlot variety from (17. IX) [85.08±0.21 (28 buds); 87.45±2.18 (20 buds); 83.08±0.02 (36 buds)] recorded the highest values.

CONCLUSIONS

i. The ecoclimatic conditions in the Dealu Bujorului, Bujoru Wine Centre, highlighted the exceptional viticultural value as well as the authenticity encountered in the wide variety of wines produced in the studied areas. Based on the results regarding the qualitative assessment of the tested varieties, they have a very good suitability in the studied areas.
ii. Through this present research have been shown that the grape maturity index have an influence on each other; in other words, the phenolic maturity of the red wine varieties from Dealu Bujorului are directly contingent on all these parameters.
iii. The results showed the suitability of ecoclimatic conditions and the proper growth and development of the tested varieties for obtaining wines with superior's quality. Under the ecoclimatic conditions of 2017, the grapes entered in the ripening process prematurely, and full maturity was very early. The dynamics accumulation of the sugars and color compounds until the harvest was alert.

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Table 2. Grape maturity index of Feteasca Neagra and Merlot at harvest in 2017 (mean ± standard deviation)

Data of sampling	Variety	Culture system	The weight of 100 berries (g)	pH	Total acidity (g/L H_2SO_4)	Sugar content (g/L)	Total anthocyanins potential (mg/L)	Anthocyanin extractability (AE)	Percentage of extractable anthocyanins (PEA)	Total phenolic richness (RPT)	Total content of tannins in skin	Total content of tannins in seeds (ST)	Maturity of seeds MP (%)
13. VIII	Feteasca Neagra	28	123.75±0.34 d	3.15±0.04 hi	9.83±0.09 d	160.40±1.95 x	981.67±9.98 u	528.90±14.36 e	45.94±1.64 s	18.03±0.61 fg	10.55±0.29 e	7.49±0.59 l	41.42±2.15 jkl
		20	119.27±0.96 g	3.13±0.04 i	10.40±0.13 C	171.14±0.99 v	1099.09±34.99 r	454.98±15.55 g	58.60±0.86 r	15.49±0.50 h	9.12±0.31 g	6.43±0.38 mn	41.40±1.60 kl
		36	117.23±0.95 h	3.11±0.05 i	10.53±0.06 b	160.10±0.90 x	1220.57±17.92 o	490.94±5.88 f	59.25±0.02 pr	17.59±0.53 g	9.80±0.12 f	7.78±0.47 l	44.18±1.40 ijkl
	Merlot	28	125.09±0.39 c	2.96±0.04 j	9.84±0.26 d	171.13±0.18 v	1060.51±19.53 ij	366.26±0.78 i	67.25±0.07 m	13.38±0.60 i	7.32±0.02 i	6.06±0.61 mn	45.26±2.51 hijk
		20	118.28±0.17 H	3.11±0.12 i	11.87±0.22 A	143.36±0.81 y	824.32±4.02 v	318.68±1.95 j	65.21±0.08 n	12.51±0.50 ij	6.35±0.04 j	6.15±0.52 mn	49.09±2.22 h
		36	130.30±0.81 b	2.96±0.12 j	9.63±0.15 d	162.39±0.43 x	810.25±2.01 v	326.95±2.37 j	62.47±0.26 op	16.67±0.61 j	6.53±0.05 j	6.14±0.57 n	41.16±2.78 kl
20. VIII	Feteasca Neagra	28	120.48±0.8 l	3.19±0.06 ghi	6.62±0.08 e	210.38±0.27 n	1802.71±17.92 f	490.15±6.27 f	72.79±0.60 hi	25.93±2.10 bc	9.78±0.13 f	16.13±1.92 bcdef	62.07±2.61 e
		20	117.47±0.32 h	3.20±0.09 fghi	6.65±0.08 e	212.46±0.11 m	1678.61±11.85ij	499.73±8.10 f	72.79±0.54 jk	25.93±1.06 bc	9.78±0.16 f	16.13±0.97 cdefg	60.30±1.43 ef
		36	114.34±0.23 k	3.30±0.03 defgh	6.67±0.10 e	209.32±0.33 o	1474.27±0.00 l l	490.15±1.55 h	70.22±0.11 i	25.33±1.14 bc	8.26±0.03 h	14.97±1.17 abcd	67.30±1.56 d
	Merlot	28	124.43±0.66 c	3.14±0.06 i	6.71±0.43 e	182.47±0.60 t	1363.16±11.85 m	425.76±0.45 h	68.76±0.24 kl	25.33±1.11 bc	8.52±0.01 h	16.68±1.11 bcde	66.16±1.52 d
		20	116.35±0.11 i	3.14±0.05 i	6.20±0.08 f	174.30±0.98 u	1748.58±11.85 g	380.49±5.05 i	78.23±0.22 fg	24.20±1.71 cd	7.61±0.10 i	16.59±1.67 bcdef	66.99±2.06 d
		36	106.35±0.11 r	3.15±0.04 hi	5.70±0.11 gh	184.10±0.26 s	1839.11±13.44 e	402.70±14.78 h	78.08±0.74 fg	25.20±1.72 bc	8.24±0.30 h	17.41±1.45 abc	68.45±2.02 d
27. VIII	Feteasca Neagra	28	117.36±0.29 h	3.41±0.03 abcd	4.87±0.12 jk	240.43±1.73 h	1730.47±13.44 gh	648.02±1.02 a	61.66±0.41 no	24.39±1.60 cd	13.25±0.05 a	11.14±1.63 k	45.47±3.72 hij
		20	115.42±0.57 j	3.42±0.05 abcd	5.87±0.21 g	246.43±0.57 g	1655.46±8.96 j	668.85±0.23 a	58.94±0.26 r	26.26±2.05 bc	13.58±0.04 a	12.68±2.01 hijk	48.04±4.03 hi
		36	113.39±0.62 l	3.46±0.08 abcd	4.91±0.25 j	238.36±0.60 i	1902.48±15.02 c	658.00±2.14 a	65.68±0.79 m	24.92±1.10 bc	13.19±0.02 a	11.73±1.10 jk	46.97±2.33 hi
	Merlot	28	135.75±0.34 a	3.31±0.08 fghi	5.58±0.13 hi	204.34±0.13 r	1445.94±17.02 l	535.96±11.31 e	62.92±0.95 n	18.06±0.61 fg	10.71±0.23 e	7.35±0.40 l	40.64±0.90 l
		20	122.46±0.12	3.38±0.09	5.53±0.30	206.16±0.26	1709.78±27.25 hi	661.66±4.18	61.63±0.68	20.26±0.90	13.10±0.03	7.14±0.88	35.20±2.76

Data of sampling	Variety	Culture system	The weight of 100 berries (g)	pH	Total acidity (g/L H_2SO_4)	Sugar content (g/L)	Total anthocyanins potential (mg/L)	Anthocyanin extractability (AE)	Percentage of extractable anthocyanins (PEA)	Total phenolic richness (RPT)	Total content of tannins in skin	Total content of tannins in seeds (ST)	Maturity of seeds MP (%)
			e	bcde	hi	p		a	no	ef	a	l	m
		36	118.49±0.19 h	3.35±0.08 defg	5.49±0.16 hi	204.39±0.29 r	1722.71±13.44 gh	547.59±5.88 d	68.20±0.49 l	18.52±0.50 efg	10.94±0.12 de	7.57±0.61 l	40.86±2.19 l
03. IX	Feteasca Neagra	28	115.50±0.10 j	3.36±0.06 defg	4.56±0.18 lm	260.39±0.08 d	1228.65±29.38 o	234.08±0.45 l	80.93±0.48 e	19.99±0.40 efg	4.67±0.01 l	14.32±0.41 fghi	75.34±0.56 c
		20	116.50±0.10i	3.24±0.06 efghi	5.38±0.14 i	258.33±0.10 e	1171.75±15.52 p	231.76±1.95 l	80.21±0.43 e	18.26±1.21 efg	4.63±0.04 l	13.63±1.17 ghij	74.55±1.48 c
		36	112.50±0.10 m	3.39±0.05 bcde	4.25±0.05 mn	260.34±0.15 d	1042.42±4.48 s	234.60±4.27 l	77.48±0.51 g	19.26±0.46 efg	4.68±0.09 l	14.57±0.43 efgh	75.66±0.57 c
	Merlot	28	114.42±0.11 k	3.56±0.28 a	5.06±0.03 j	235.26±0.16 j	1880.50±19.53 d	597.50±0.78 b	68.20±0.31 l	25.52±1.70 bc	11.94±0.02 b	13.57±1.69 ghij	53.04±3.09 g
		20	111.46±0.13 n	3.36±0.05 cdef	4.60±0.11 kl	229.62±0.19 k	2247.18±8.23 a	566.21±0.45 c	74.00±0.18 h	32.96±0.17 a	10.18±0.18 cd	21.97±4.78 a	62.40±2.30 e
		36	114.41±0.11 k	3.39±0.06 bcd	4.42±0.12 lmn	227.23±0.12 l	2089.22±12.26 b	572.68±46.58 c	71.68±2.84 ij	27.12±1.42 b	11.44±0.93 c	15.67±1.93 cdefg	57.66±4.53 f
10. IX	Merlot	28	110.36±0.11 o	3.52±0.08 abc	4.60±0.12 kl	263.43±0.13 c	1295.91±20.53 n	192.36±1.17 m	82.32±0.12 c	20.51±1.53 e	3.91±0.05 m	16.59±1.58 bcdef	80.81±1.63 b
		20	109.47±0.14 p	3.53±0.06 ab	4.31±0.11 lmn	256.34±0.24 f	1549.40±16.15 k	193.73±1.23 m	81.02±1.12 b	20.19±1.80 ef	3.95±0.68 m	16.23±1.56 bcdef	80.39±2.87 b
		36	110.31±0.10 o	3.43±0.04 abcd	4.33±0.12 lmn	261.29±0.18 d	1282.98±22.40 n	279.62±34.06 k	78.21±2.46 fg	17.92±0.61 fg	5.58±0.68 k	12.33±0.21 ijk	68.85±2.75 d
17. IX	Merlot	28	101.33±0.11 t	3.41±0.05 abcd	4.28±0.01 lmn	301.13±0.17 b	982.92±11.85 t	167.36±3.23 n	82.96±0.13 d	19.39±0.72 efg	3.34±0.06 n	16.04±0.67 bcdef	85.08±0.21 ab
		20	106.22±0.09 r	3.46±0.04 abcd	4.23±0.05 n	287.29±0.36 a	1267.46±4.48 n	123.69±1.25 o	88.58±0.21 a	17.66±1.50 g	2.67±0.08 o	14.99±1.55 defg	87.45±2.18 a
		36	103.39±0.14 s	3.37±0.03 cdef	4.32±0.17 lmn	299.08±0.05 b	1060.52±4.48 s	218.57±0.90 lm	79.38±0.09 ef	22.66±0.70 d	4.38±0.02 lm	18.29±0.70 ab	83.08±0.02 b
Average			109.24	3.23	6.29	231.58	1278.111	415.73	70.9	21.00	8.31	12.68	59.65
F (Fisher Factor) *Sig.*			562.365 ***	3.589 ***	437.102 ***	1245.150 ***	1147.006 ***	452.273 ***	331.296 ***	44.970 ***	451.763 ***	39.968 ***	139.087 ***
Data of sampling		*Sig.*	***	***	***	***	***	***	***	***	*Ns*	***	***
Culture system		*Sig.*	**	*ns*	**	*ns*	*ns*	*ns*	*	*ns*	***	*ns*	*Ns*
Data of sampling x Culture system		*Sig.*	***	*ns*	**	*ns*	*ns*	*ns*	**	*ns*	*ns*	*	***

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