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Influence of Different Factors on the Quality of Wine Grape Varieties in some Areas of Romania in 2010

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Abstract. Among the organic substances contained in the chemical composition of grape wine utmost importance for assessing the quality is given by the sugars and the organic acids. Sugar content in grapes is influenced by several factors, such as biological characteristics of varieties and growing environment. Among endogenous factors, the temperature influences most the grape sugar content, which is correlated positively or negatively with acidity. Thus the four varieties of wine under study, (Pinot noir, Fetească neagră, Fetească albă and Muscat Ottonel), grown in three areas, with very different environment conditions (Timişoara, Iaşi and Cluj-Napoca), were found positive correlations between the amount of carbohydrates accumulated, titratable acidity and temperature. The varieties have accumulated more carbohydrates in Timişoara (Pinot noir 240g / l) and the fewest in Cluj-N (Fetească albă 181 g / l). One can observe a negative relationship between sugar and acid content.

Keywords: grapes, quality, sugar, acidity, climatic factors, temperature

INTRODUCTION

The quality of the grapes at maturity is given by an optimal ratio between sugar and acidity, and a maximum concentration of phenolic compounds. In viticulture there are many factors that determine the quality of the harvest: climatic factors, soil, variety, technology management and the interaction of all those mentioned above. Obtaining high-quality crops require good knowledge of all these factors.

The light plays an important role in grape maturation and quality influencing a number of physiological processes. This may influence fruit composition by thermal effects and chromatic photosynthesis, involving different frequency radiation (Smart, 1987).

The most important environmental factor that is a limited character for the delimitation area and spreading culture of the vine is the temperature. This affects the life processes of vine by the temperature (lower thresholds, thresholds, higher optimum level, critical moments) and the amount of degrees of temperature (thermal balance global, active heat balance, useful heat balance). (Coombe, 1987, Pop, 2010). During maturation, the temperature plays a decisive role for the quality of grapes, including flavor and color with a significant effect on the characteristics of wines (Jackson and Lombard, 1993). Different level of water in the soil affects the quality of grapes and is reflected in the wine quality. Conradie, in 2002, shows that in regions with high rainfalls the ripening capacity of grapes is smaller.

It was noted that in temperate regions which generally do not suffer from drought, a certain lack of water during the ripening period is favorable for the organoleptic qualities of wine (Riou, 1994). Riou et al. in 1994, developed an index of soil for water potential equilibrium, that gives information about the quality of grapes for wine for use in various macroclimate (Carbonneau, 1994).

Taking into account even the most important descriptions of the wine growing regions climate (Bentryn, 1988), they may be available only as indices, being insufficient to analyze

the relationship between wine and abiotic factors of the regions (Tonietto, 2004).

To understand the potential quality of grape varieties (sugar, acidity, phenols), they should be analyzed for each area separately.

MATERIAL AND METHOD

The biological material used in this study is represented by four varieties of grapes for wine: Pinot noir, Fetească neagră, Fetească albă and Muscat Ottonel, in 2010, in three different areas: The grape collections of USAMV Cluj-Napoca, USAMV Iaşi and USAMVB Timişoara. The varieties were harvested at different times depending on the timing of full maturation, specific for each area. Optimum harvest time was chosen according to the protocol described by POMOHACI et al., 2000. Such from entry into veraison, grape samples were taken with an average of 1.5 - 2 kg consisting of 4-5 clusters of berries, harvested from the base, middle and top of the grape, the entire length of strings and at least 10 -15 hubs. Samples are collected at the beginning from five to five days, and to near maturation every third day. Determinations were made by separating the grain from the stalk by cutting with scissors under the brush. There were made for each variety samples of 300-1000 berries, which were then crushed. The solid parts of grapes wew separated from the liquid fraction and the determination of the sugar and acidity content was performed. Based on the results we were establishing the right moment of the maturation. So the first mature variety was Muscat Ottonel in Timisoara on 16 September and the latest was in Cluj, the variety Fetească neagră on 9th of October 9 (Tab. 1).

Tab. 1

The optimum date for grapes harvest in the three areas for the year 2010

Area	Variety			
	Muscat Ottonel	Fetească albă	Fetească neagră	Pinot noir
Timişoara	16 09	18 09	18 09	16 09
Iaşi	18 09	20 09	20 09	17 09
Cluj	27 09	02 10	09 10	04 10

The Sugar determination was made with Zeiss refractometer, with an error of ± 0.2%. Three determinations of dry substances were made and the results were the corrected according to the value of the temperature. The grape sugar content was calculated using the formula:

$$\% \text{ Sugar} = (N * 4.25): 4 - 2.5$$

Where N is the dry matter, 4.25 ratio between the density and refractive index and 2.5 must average content of organic substances other than grape sugars.

Titratable acidity was determined from the liquid fraction of the grapes, by neutralizing the acidity from 10 cm³ of wine, with NaOH (N = 0.1). Phenolphthalein indicator was used with a concentration of 1%. Acidity was expressed in g / l sulfuric acid and calculated using the formula:

$$X = (n * F * 0.0049) \times 100$$

Where N is cm³ of NaOH used to neutralize, F is the correction factor (0.1) and 0.0049 is the amount in grams of sulfuric acid corresponding to one cm³ of NaOH solution.

The statistical interpretation of results was performed using correlation coefficient (r) (Ardelean *et al.*, 2007)

RESULTS AND DISCUSSION

To characterize the general climate of the investigated areas, we used the data recorded at meteorological stations of USAMV Cluj-Napoca, USAMV Iaşi and USAMVB Timişoara. In terms of territorial climate the areas analyzed are totally different. Cluj is the area with a moderate continental climate, being at the northern limit of cultivation of the vine, in 2010 registering an average temperature of 9,5°C with almost a degree Celsius lower than in Iaşi (10,4^{o}C) and almost three degrees lower than in Timişoara (12,3^{o}C). Iaşi is largely influenced by the presence of Atlantic and continental anticyclone, the temperature is temperate continental specific lands. Absolute maximum and absolute minimum temperature (Tab. 2) were recorded in Iaşi (40,1^{o}C, respectively - 27, 2^{o}C). Timişoara within moderate continental climate, typical of the south-eastern part of the Pannonian Basin, with some sub-Mediterranean influences. Frequently, even in winter, the air masses arriving from the wet Atlantic are bringing substantial rain and snow, rarely cold waves.

Tab. 2

Rainfalls levels and the temperatures for the year 2010 in the three areas

	Monthly average temperatures ^{o}C												Med
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Timiş	-0.2	3.3	7.9	12.9	17.0	21.0	24.2	22.7	17.0	10.2	10.2	1.2	**12.3**
Iaşi	-6,0	-0,7	4,5	11,1	17,3	20,8	23,3	24,0	15,6	7,5	10,3	-2,9	**10,4**
Cluj-N	-2.7	-0.7	8.4	10.9	14.9	19.7	21.7	16.8	13.7	6.9	6.5	-1.9	**9.5**
	Monthly maximum temperatures ^{o}C												Maxi
Timiş	14.7	16.1	20.6	24.3	28.5	34.6	34.3	36.1	28.2	20.6	21.9	16.1	**36.1**
Iaşi	15.4	22.5	25.1	29.8	36.0	37.4	40.1	39.0	33.1	32.1	27.6	17.9	**40.1**
Cluj-N	10.4	10.9	15.9	20.1	24.3	30.7	34.1	27.8	21.5	16.7	14.1	9.5	**34.1**
	Monthly minimum temperatures ^{o}C												Min
Timiş	-10.4	-7.2	-6.1	3.8	7.3	8.7	14.3	11.2	8.2	-1.3	-0.1	-11.2	**-10.4**
Iaşi	-24.4	-20.9	-15.3	-5.6	-0.6	6.9	7.6	7.1	2.2	-6.7	-21.1	-27.2	**-27.2**
Cluj-N	-19.6	-9.8	-3.5	3.4	6.7	11.7	13.5	13.2	7.8	-0.6	-3.6	-16.8	**-19.6**
	Precipitation mm												Σpp
Timiş	32,3	29,3	48,4	36,8	54,8	116,8	40,4	38,4	61,2	53,6	52,8	47,9	**612,7**
Iaşi	47,2	36,8	13,1	24,9	61,4	139,5	25,2	49,9	51,5	40,8	45,3	32,9	**568,5**
Cluj-N	21,2	19,5	27,0	49,6	97,6	93,8	59,7	71,2	44,3	35,8	32,4	30,8	**555,9**

Global thermal balance is the sum of all positive daily average temperatures during the active life of the vine (Pop, 2010), i.e. from the beginning to phenophase of crying until the phenophase of leaves falling(Tab. 3).

Tab. 3

The main elements of climate in 2010

Area	Air bioactive period (days)	Thermal balance			Hidrotermic ratio
		Global ^{o}C	Active ^{o}C	Useful ^{o}C	
Timişoara	204	3798	3432	1460	1,15
Iaşi	208	3790	3212	1432	1,22
Cluj-Napoca	176	2931	2806	1180	1,61

The data from the chemicals analysis are summarized in Tab. 4. This can be seen that the smallest amount of sugar in all varieties that was obtained in Cluj-Napoca. Also the highest titratable acidity was expressed in H_2SO_4 in the same area (Fetească albă 6.0 g / l).

In Tab. 3 we can see that Cluj-Napoca have the lowest overall thermal balance of the three areas and the highest was obtained in Timisoara. However the difference in temperature is not very great between the Iasi and Timisoara area, which is only 8°C in favor of the latter. The precipitation falls in normal values for the vines growing in all three areas.

By calculating the hidrotermic ratio, which is the ratio of Σpp (mm) and Σta (° C), multiplied by 10 of the vegetation period (Seleaninov, 1936 cited by Pop, 2010), Timişoara and Iaşi obtain values of 1,15 respectively 1,22, which expresses that in those areas one can harvest constant production of high yields and quality. In Cluj-Napoca the same coefficient has a value of 1,61 that indicates high yields with less quality than in the other two areas, due to lower temperatures.

Tab. 4

Sugar content, titratable acidity expressed in H_2SO_4 and glucoacidimetric index for the varieties analyzed

Area / Variety	Timişoara			Iaşi			ClujNapoca		
	Sugar (g/l)	Titrable acidity (g/l)	Gluco acidimetric index	Sugar (g/l)	Titrable acidity (g/l)	Gluco acidimetric index	Sugar (g/l)	Titrable acidity (g/l)	Gluco acidimetric index
Muscat Ottonel	208	3,3	63,0	207	3,3	62,7	192	3,7	51,9
Fetească albă	210	4,5	46,7	209	4,6	45,4	181	6,0	30,2
Pinot noir	210	4,4	47,7	210	4,5	46,7	201	5,8	34,7
Fetească neagră	240	4,5	53,3	230	4,6	50,0	203	5.6	36,2

In Timişoara all varieties had the greatest amount of carbohydrates but very close in value to those of Iasi. Thus Fetească neagră accumulated the largest quantity of sugar in Timişoara (240g g/l), and the smallest quantity in Cluj-Napoca (203g/l).The titratable acidity for the same variety grown in inverse proportion to the amount of carbohydrates accumulated so the largest amount recorded was in Cluj-Napoca (5,6 g/l) and the lowest in Timişoara with 4.5 g/l. The same trend can be seen in the other varieties. Very high values of the glucoacidimetric index was recorded in the case of Muscat Ottonel due to a low titratable acididity.

The graph represented in Fig. 1 reveals the acidity for the four varieties of grapes according to the global heat balance. Although the four varieties present different amounts of acidity depending on the particularities of each variety, for to all this acidity may be linked to global heat balance. The value of r is over 0,99, value the statistically proved.

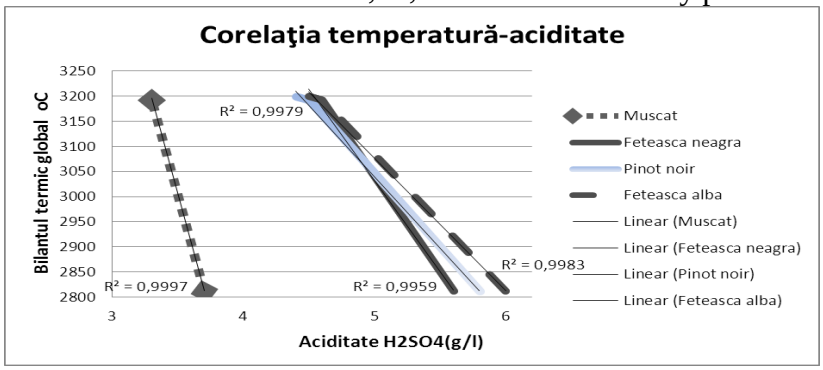

Fig. 1 The acidity for the grape varieties grapes in 2010

Correlations

The relations between quality attributes of grapes acquired for the four varieties and temperature were statistically processed using correlation coefficient that determines the relationship between variables. Tab. 5 were systematized data on varieties and the correlation between them.

Tab. 5

The correlation coefficients between variables

Variety (Area)	Sugar g/l	Titrable acidity g/l	Gluco acidimetric index	Global thermal balance (°C)	Correlation temperature/ sugar	Correlation temperature/ acidity
Muscat Ottonel(CN)	192	3,7	51,9	2812	0,9986	0,9997
Muscat Ottonel (I)	207	3,3	62,7	3192		
Muscat Ottonel(T)	208	3,3	63,0	3200		
Fetească neagră(CN)	203	5,6	36,3	2812	0,9997	0,9959
Fetească neagră(I)	238	4,6	51,7	3192		
Fetească neagră(T)	240	4,5	53,3	3200		
Pinot noir(CN)	201	5,8	34,7	2812	0,9991	0,9979
Pinot noir(I)	210	4,5	46,7	3192		
Pinot noir(T)	210	4,4	47,7	3200		
Fetească albă(CN)	181	6	30,2	2812	0,9998	0,9983
Fetească albă(I)	209	4,6	45,4	3192		
Fetească albă(T)	210	4,5	46,7	3200		

In every case we found a correlation of the amount of sugar with the global heat balance of 2010 expressed as the sum of degrees. Thus the values r, for the link between temperature and acidity and also for the link between temperature and accumulation of sugar, are over 0,995, a value greater than or equal to the value of P 5%. Although there are a small number of cases, all correlations are statistically proved. The significantly distinct correlation coefficient in these cases both between temperature and sugar content and between the temperature and acidity suggest a real link between those two parameters. This can be explained by the fact that 2010 was a typical year: the global heat balance ranged from the normal values for each zone.

In these cases, the positive correlation coefficient, significant between the two variables taken into account indicates the dependence between them. The global heat balance thus increases with the increasing sugar content and acidity decreases. This result is expected given that there is a positive correlation between temperature and quality grape harvest.

CONCLUSIONS

The chemical analysis of the four varieties from the three different centers and the analysis of the temperature led to the establishment of links between the two variables. Thus in all four varieties we obtained a correlation between temperature and the sugar content and even a correlation for temperature-acidity. The conclusion that emerges from these data is that for the quality grape harvest, the temperature is the limiting factor with the most important role.

Given the fact that the quality of the yield is influenced mostly by the ratio between sugar and acidity, all the three areas respected the limits for this parameters and for the ratio between them for the year 2010. These limits are imposed by the geographical coordinates of each area with the influence of specific factors such as soil, temperature, precipitation, technology management and the interaction between them.

The parameters mentioned above were in normal limits with optimal values for each area for the year 2010. This conclusion emerges from the fact that the grapes from all varieties were well developed and fully ripen by the third decade of September for Iași and Timișoara, and by the first decade of October in Cluj-Napoca.

Due to the period of the full maturity, for the year 2010 in Iași and Timișoara the growers had the possibility to leave the grapes for over maturation with a positive effect on the quality of wine obtained from these overripe grapes.

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