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Research concerning the evolution of grape maturation and polyphenols content in two red wine grape cultivars in the conditions of Timisoara (Romania)

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Abstract Research was carried out in 2011, in the experimental viticultural plantation of the Didactic Station of the Banat University of Agricultural Sciences and Veterinary Medicine in Timisoara, Romania, and it monitored the evolution of grape maturation and of total polyphenols on two red wine grape cultivars: Cabernet Sauvignon and Merlot.

The Cabernet Sauvignon grape cultivar always satisfies from the point of view of the wine quality it produces: it constantly guarantees high-quality wines with optimal alcohol potential, rich in phenol extract and compounds, with a good balance of physic-chemical features.

The Merlot grape cultivar has features similar to those of the Cabernet grape cultivar, competing with the latter in achieving sustained productions.

Since harvesting wine grape cultivars is done upon technological maturity, we need to measure 100-berry weight, must sugar content in g/l, must acidity content in g/l of H_2SO_4, as well as colouring substance content if we wish to establish optimal harvesting time.

As a result of our research on the two red wine grape cultivars, we could see that high temperature and long duration of sunshine during grape maturation in the fall of 2011 allowed the accumulation of enough amounts of colouring substances. We could also see that total polyphenols reached higher values in the berry skin, their amount increasing until technological maturity.

Key words

polyphenols, technological maturity, cluster, technological indices

Viticulture contributes to the valorisation of the lands at national level, covering slope lands and rocky and sandy lands. It is that branch of agriculture that supplies raw material for wine making.

According to the phrase "a good wine starts in the vineyard", it is very important to tend grapevine properly, both during rest and during vegetation: the amount and quality of the grapes depend on each year's grape production.

Starting from the fact that wine, like any other living thing, is born, lives, and dies, it is understandable that wine production technology, from the grape to the bottling of the wine, is something precise resulting in value, quantitatively and qualitatively.

Achieving all physic-chemical parameters necessary to any type of wine at bottling time is possible only if we pay enough attention to care works, starting from grape processing, must processing, and wine formation and maturation phases.

Phenolic components influence the organoleptic properties, highlighting the astringency, flavor, hardness, color, etc..

Ravac wine is low in tannins than the must obtained from the press, where tannins can reach up to 1g, and during maceration, leather dyes, beans, pass the wine, the amount of anthocyanin extracted was dependent on the technology used.

Another factor on which depend the amount and quality of grape production and, implicitly, of wine production, are soil and climate conditions in the cultivation area – in our case, the Didactic Station of the Banat University of Agricultural Sciences and Veterinary Medicine in Timisoara, Romania – with chernozem as predominating soil, with an amount of precipitations of 550 mm annually, and with 1,800-2,000 h of sunshine annually.

Material and Method

Research was carried out in 2011 in the experimental viticultural plantation of the Didactic Station of the Banat University of Agricultural Sciences and Veterinary Medicine in Timisoara, Romania.

To carry out the research, we studied two wine grape cultivars, Merlot and Cabernet Sauvignon, cultivars with a large share among high-quality red wine grape cultivars.

Since well knowing raw material, the main components and their evolution during maturation are essential in establishing the technological scheme of producing the desired type of wine, we estimated optimal harvesting time in the two studied red wine grape cultivars: 100-berry weight, must sugar content in g/l, must acidity content in g/l of H_2SO_4, as well as colouring substance content if we wish to establish optimal harvesting time.

We harvested grape samples of 2.0-2.5 kg on the average from different points of the plot to make it most representative, after which we labelled the samples and we took them to the laboratory for analysis.

Due to the fact that full maturation in the studied area is reached around September 25, the samples were harvested starting with August 21, at a 5-day interval.

We detached the berries from the sample clusters, after which we numbered and weighed them, and we determined the weight of 100 berries.

Determining sugar content was done through the refractometric method consisting in determining dry matter with a portable Zeiss refractometer. To do so, we crushed the berries with laboratory press and we left the must clear and we did the reading with a refractometer.

After we did the corrections depending on must temperature, we turned the dry matter read with the refractometer into sugar with the formula:

$$\text{Sugar (g/l)} = \left[\frac{N \times 4.25}{4} - 2.5 \right] \times 10$$

where:

- Z – sugar in g/l;
- N – corrected reading of dry matter in the refractometer;
- 4.25 – ratio between density and must refractometric index;
- 2.5 – mean dry non-sugar matter content (%) in must;
- 4 – coefficient empirically established on the ground of a large number of measurements.

Determining acidity was done by titrating must acids with a solution of NaOH (known titre) and having phenolphthalein as an indicator. Acidity was calculated with the formula:

$$\text{Acidity g/l} = n \times F \times T \times 100$$

where:

- n – ml of solution of NaOH 10n used in titrating;
- F – factor of the solution of NaOH ;
- T – titre of the acid in which acidity is expressed, reaching 0.0049 when expressed in sulphuric acid.

To determine colouring substances in the grapes, we sampled a medium amount of grape berries which we weighed, removing the skin which we then dried for 24 h, adding 25 mm HCl 1%.

After one day, we added another 75 mm HCl 1%, the total amount being 100 ml. We then separated the extract by centrifugation and we measured chromatographically the type of colorants, which we could have also done with a spectrophotometer. Calculus was done by relating the value thus obtained and the amount of grape berries.

Results obtained

Sugar content and total acidity are the main components of grapes of great importance in the wine making process.

Determining grape maturation in the grape cultivars we studied was done monitoring the process of sugar accumulation and of decrease of acidity in the berries, together with the weight of 100 berries, which helps establishing with high precision optimal harvesting time.

Table 1 shows the three indicators during grape harvesting.

Table 1

The mean, minimum and maximum weight of 100 berries, sugar and acidity

Cultivar	Weight of 100 berries (g)			Sugar (g/l)			Acidity (g/l H_2SO_4)		
	minimum	maximum	medium	minimum	maximum	medium	minimum	maximum	medium
Cabernet Sauvignon	97	128	112,5	189	236	212,5	4,2	7,1	5,4
Merlot	102	136	117,0	185	249	216,0	4,5	6,8	5,7

Studying the three components from ripening to harvesting in table 2, we can see that:

-the weight of 100 berries increased until around September 27, after which there was a decrease of the value;

-sugar accumulated in great amounts in the berries, ever since the beginning of the interval, increasing steadily until harvesting; the most intense sugar accumulations were towards full maturity;

total acidity reached decreasing values, with smaller differences towards the end of the studied interval.

Table 2

Evolution of grape maturation in the grape cultivar Cabernet Sauvignon

No.	Date	Weight of 100 berries (g)	Sugar (g/l)	Acidity (g/l H_2SO_4)	Gluco-acidimetric index
1	21.08.	120,3	118	10,0	1,2
2	27.08.	121,4	138	9,7	1,4
3	31.07.	121,7	154	8,8	1,7
4	05.09.	122,1	170	8,0	2,1
5	10.09.	122,7	184	7,5	2,4
6	15.09.	123,6	191	6.9	2,8
7	21.09.	124,3	198	6,8	2,9
8	27.09.	125,0	206	6,4	3,2
9	03.10.	123,7	214	6,1	3,5
10	08.10.	122,6	222	5,5	4,0

Table 3

Evolution of grape maturation in the grape cultivar Merlot

No.	Date	Weight of 100 berries (g)	Sugar (g/l)	Acidity (g/l H_2SO_4)	Gluco-acidimetric index
1	21.08.	118,6	122	9,5	1,3
2	27.08.	119,8	131	9,0	1,4
3	31.07.	120,6	148	8,2	1,8
4	05.09.	120,9	160	7,5	2,1
5	10.09.	121,4	168	7,3	2,3
6	15.09.	122,2	177	7,0	2,5
7	21.09.	123,0	186	6,8	2,7
8	27.09.	123,4	194	6,5	3,0
9	03.10.	122,4	204	6,0	3,4
10	08.10.	121,7	210	5,7	3,7

We also calculated the glucose-acidimetric index representing the ratio between sugar and acidity. It reached values ranging between 1.0 and 1.5 during the ripening period and of 3.5-4.0 upon full maturity.

The main indicator of the optimal harvesting time was the concordance between sugar curve, total acidity, and weight of 100 grape berries. This was reached in both grape cultivars around September 27.

Table 4 shows the dynamics of total polyphenols during grape maturation in the conditions of the year 2011, when research was carried out. The table shows that total polyphenols in must increase steadily from the ripening period reaching a maximum during full maturity. After this period, there is a decrease of their content in the must.

The amount of polyphenols in the must differs a little in the two grape cultivars, with higher values in the Cabernet Sauvignon grape cultivar.

Total polyphenols in the skin play an important role due to both their amount and their contribution to the quality and evolution of the red wine.

Table 4

Quantity of total polyphenols (g/l tannic acid)

Date	Cabernet Sauvignon	Merlot
21.08.	0,25	-
27.08.	0,27	0,17
31.07.	0,30	0,20
05.09.	0,31	0,30
10.09.	0,32	0,31
15.09.	0,37	0,30
21.09.	0,42	0,47
27.09.	0,33	0,34
03.10.	0,37	0,25
08.10.	0,37	0,27

Conclusions

Climate conditions in 2011 in Timişoara were favourable to high-quality red wine grape cultivars, and high temperature and long duration of sunshine during maturation allowed the accumulation of sufficient amounts of colouring matter.

As for reaching full maturity in the two studied grape cultivars, they reached it at about the same time.

Harvesting red wine grape cultivars should be done when the content of phenol compounds is maximal, and the other features reach optimal values of the type of wine we wish to produce.

Establishing the time and order of harvesting grape cultivars largely depends on the state of health of the plantation.

Total polyphenols had values higher in the skin compared to the must, which shows that only part of them dissolved; this justifies the necessity of maceration in red wine production technology, maceration ensuring the four main features of red wine: colour, tannin content, extract substances, and aroma.

Due to the fact that, through wine making, there is no complete extraction of antocyans, we can draw the conclusion that, besides technology, grape cultivar and particularly harvesting time contribute essentially to proper colour wines.

It is known that, through fermentation, losses are rather high, so that harvesting red wine grape cultivars should be done when the content of phenol antocyans is maximal.

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