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Evolution of polyphenols during the maceration of the red grapes

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Abstract

The Cabernet Sauvignon grapes from Dealu Mare vineyard may accumulate great quantities of phenols compounds, which assure wines with high chromatic indices and a harmonious chemical composition. In this study the influence of several parameters on maceration fermentation was monitored. It was observed that the addition of SO2, enzymatic preparation Vinozym®Vintage FCE and also the maceration equipment have a high influence on the final phenolic composition and on the chromatic characteristics of wines.

Keywords: enzymes, red wine, polyphenols

1. Introduction

The composition of phenolic compounds in red wine is one of the main determinants of its quality. Some sensory attributes such as color, body and astringency are directly associated with the composition of anthocyanins and proanthocyanidins [1].

Anthocyanins are only present in grape skins whereas proanthocyanidins, also known as condensed tannins, are present in skins, seeds and stems [2].

The main importance of red winemaking is the maceration stage when components from solid parts of grapes are dissolved in the grape must. Maceration is influenced by several factors as: time, temperature, enzymatic preparation addition, presence of SO_2 etc.

Sims and *Bates* [3] recorded the maximum rate of anthocyanins extraction between days 4 and 6 of fermentation of crushed grapes. A longer maceration resulted in an increase in the content of polyphenols, which was positively manifested as late as during the storage and maturation of red wine [4]. After seven days of fermentative maceration, Romero-Cascales [5] observed only minimum changes in the content of anthocyanins and they therefore discussed the effects of adsorption and degradation of yeast cell walls. Mandžukov [6] mentioned that after the stage of the maximum concentration of anthocyanins in the liquid phase of wine their concentration decreased either due to their degradation or their adsorption on particles that did not contain these pigments.

The aim of this study was to evaluate the influence of some fermentation conditions on phenolics content, and color intensity of red wine

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2. Materials and methods

Grapes Cabernet Sauvignon variety were obtained from private vineyards in Dealu Mare region during the period 2009.

The grapes were manually harvested, destemmed and then crushed. The obtained mash was sulphited with a dose of 50 mg/kg or 75 mg/l and then macerated in the presence or not of an enzymatic preparation Vinozym® Vintage FCE (Novozymes, Switzerland).

The Cabernet Sauvignon grapes variety have been processed using maceration-fermentation classical technology in open containers with "floating cap" and in metal turning tanks (ROTO) with a capacity of 20000 kg. A number of 6 variants have been done, the SO_2 quantity, the equipment and the quantity of the enzymatic products used being different (Table 1).

The must density, total acidity and pH were determined by the official method OIV [7], the total phenolics were determined with Folin-Ciocalteau reagent and expressed as g/l gallic acid [8].

Colour intensity was obtained as the sum of optical densities at 420 nm, 520 nm and 620 nm, measured in 1 mm cuvette, according to Sudraud [9]. The amount of anthocyanins was evaluated by decoloration with $K_2S_2O_5$ [10]

Table 1. Variants used for experiments

Variants	Maceration-fermentation technology	SO_2 used mg/kg	Enzymatic preparation, g/kg
V_1	classical	50	-
V_2	classical	75	-
V_3	classical	50	3.5
V_4	ROTO 2x10 min/h	50	-
V_5	ROTO 2x10 min/h	75	-
V_6	ROTO 2x10 min/h	50	3.5

.3. Results and discussions

The utilization of Roto tanks is a useful procedure from technologically and economically point of view. The maceration-fermentation duration depends on the temperature (25-28°C).

In Table 2 are presented the few parameters measured during the maceration fermentation period for all six variants.

Table 2. Characteristic of must during maceration-fermentation period

Parameters	Variant V1					Variant V2					Variant V3				
	Days of maceration														
	I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V
Density, kg/m³	1098	1085	1062	1038	1011	1098	1092	1082	1073	1012	1098	1075	1065	1046	1015
Acidity, g/l	3.6	3.7	3.8	4.2	4.3	3.8	3.8	3.9	4.2	4.4	3.7	4.0	4.0	4.0	4.5
pH	3.22	3.44	3.50	3.61	3.33	3.38	3.41	3.44	3.38	3.21	3.30	3.28	3.34	3.48	3.51
Parameters	**Variant V4**					**Variant V5**					**Variant V6**				
	Days of maceration														
	I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V
Density, kg/m³	1083	1060	1048	1022	1009	1084	1065	1038	1010	1009	1083	1061	1028	1005	1005
Acidity, g/l	5.0	5.2	5.3	5.5	5.5	5.0	5.0	5.1	5.4	5.4	4.9	5.3	5.4	5.5	5.5
pH	3.22	3.50	3.62	3.44	3.40	3.31	3.50	3.40	3.31	3.31	3.31	3.40	3.50	3.34	3.32

As can be seen in table 2, the acidity of the must during maceration fermentation was lower when maceration was done in open containers and ranges from 3.6 to 4.5 g/l.

When the maceration was done in Roto tanks the acidity values were higher and ranged from 4.9 to 5.5 g/l.

No differences were observed between variants for the pH values.

The sulphitation dose of 75 mg/kg offered the best results both for the phenolic substances extraction degree and for the chromatic characteristics protection.

The adding of enzymatic product Vinozym®Vintage FCE (3.5 g/100 kg grapes) is beneficial, determining an increasing of extraction efficiency for the phenolic compounds responsible for final wine color.

The main factor influencing the diffusion of colorants compounds and tannins during maceration – fermentation process is the formed alcohol. It causes tissue changes and is the best solvent for anthocyanins.

Evolution of total polyphenols during maceration - fermentation at variants V1, V2 and V3 ranged from 1.1 to 1.95 g/l and for the variants V4, V5, V6 values ranged from 2.75 to 3.85 g/l. The highest total polyphenol content was achieved for variant V6 (fig. 1).

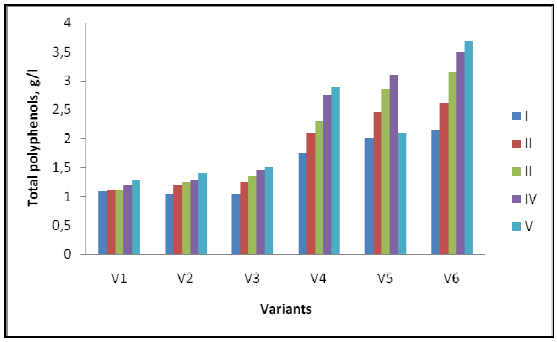

Figure 1. Total polyphenols evolution during maceration-fermentation period

Anthocyanins content have the same evolution for variants macerated in open containers, from 195-299 mg/l. In the rotary tanks the amount of anthocyanins is higher for variants macerated in a rotation scheme of 2x10 minutes/h, reaching up to 510 mg/l.

During maceration fermentation for the variants V5 and V6, anthocyanins content recorded maximum in the last two days of maceration (Fig. 2), the other variants, the amount of anthocyanins increases rapidly in the early days of maceration after which the accumulation slows.

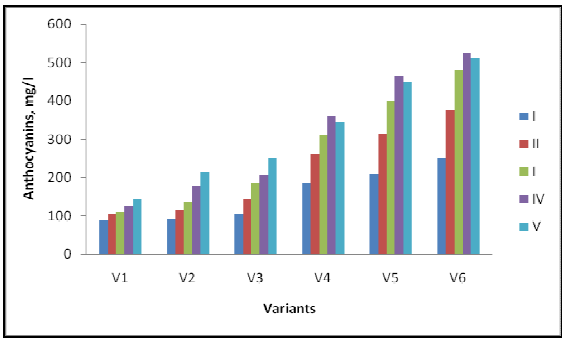

Figure 2. Anthocyanins evolution during maceration-fermentation period

The amount of anthocyanins and total polyphenols of wines at variants macerated in rotating metal tanks are superior compared with open containers, because the tanks rotation scheme accelerates the extraction of color compounds.

If the grapes are contaminated with gray mold, the process of maceration-fermentation takes place more rapidly in Roto metal tanks, as compared to that of the open containers.

In Roto tanks homogenization is done by turning the pulp maceration which improve the contact between phases and facilitates the transport of solutes in the liquid phase, thus accelerating the extraction of polyphenolic compounds from the solid parts of grape berries.

Evolution color intensity values at the end of alcoholic fermentation are between 1.5 for variant V1 and 2.7 for variant V6 (fig. 3).

At variants treated with enzyme preparations, the content of anthocyanins, polyphenols and color intensity is higher compared to the control variants.

The addition of enzyme preparations in the process of maceration fermentation induces a reduction of maceration time when is compared with the control variant. The enzyme preparations utilization in the process of maceration - fermentation will ensure a higher extraction of phenolic compounds, primarily of anthocyanins compared with the variants without enzyme addition.

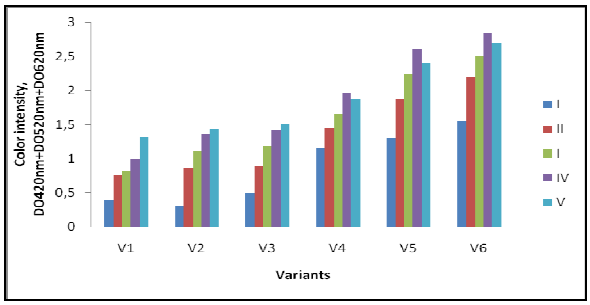

Figure 3. Colour intensity evolution during maceration-fermentation period

4. Conclusions

In the conditions of the "Dealu Mare" vineyard, the Cabernet Sauvignon grapes accumulate high quantities of phenols compounds, which assure wines with nice chromatic indices and a harmonious chemical composition especially in as far as the phenols compounds content is concerned.

The most appropriate conditions to produce red wines from Cabernet Sauvignon grapes variety are Roto tanks in order to get qualitative wine with high oenological parameters, temperature and time.

The most recommendable SO_2 dose to be administrated during the maceration process is that of 75 mg SO_2/kg must, being favourable both to the extraction of phenolic compounds from the skin and to an appropriate protection of wine colour.

The enzymatic preparation Vinozym®Vintage FCE used in the red vinification in dose of 3.5 g/kg grapes, lead to improve the phenolic compounds extraction efficiency, reflected on sensorial properties of wine, in general, but especially on the chromatic indices.

The utilisation of Vinozym®Vintage FCE products is beneficial since it influences the increasing the efficiency of polyphenolic compounds extraction from the solid parts of grapes. Obtained wines are characterised, from the beginning, by fullness, a rich colour and certain astringency.

The grapes Cabernet Sauvignon variety finds in the "Dealu Mare" vineyard favourable conditions so that the grapes could accumulate phenolic compounds in sufficient quantities to get high quality wines, which can bear the name of origin.

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