INFLUENCE OF THE THERMAL REGIME ON THE PROCESS OF FERMENTATION MACERATION IN ROTARY TANKS

— short communication —

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Abstract: This paper presents a study of the influence of the thermal regime on the process of fermentation maceration in rotary tanks for Cabernet Sauvignon grapes of Drăgăşani Vineyard. The temperatures tested are 25°C, 30°C and 35°C. The results show the positive influence of temperature on the extraction of anthocians and polyphenols in the liquid phase, with the increase of colour intensity. The maximal amount of anthocians is 1240 mg/l in the liquid phase after 36 h of maceration at 35°C; the maximal polyphenols content (2.5 g/l) is obtained also after 36 h of maceration at 35°C. In wines after 6 month the composition in these compounds is maintained relatively constant.

Keywords: fermentation, maceration, anthocians, polyphenols, Cabernet Sauvignon, Drăgăşani

1. INTRODUCTION

Fermentation-maceration is a specific operation for the technology of preparation of red wine, which aimes extraction of phenolic substances and colouring agents from the solid parts of grapes. Maceration must be conducted to achieve a selective extraction of different compounds, favouring the passage in grape juice especially of useful compounds, as anthocyanins.

Temperature is one factor that influences the process of maceration. Under the influence of temperature, permeability of cell membranes increases allowing anthocyanic pigments (called anthocyans or anthocyanins) to pass in the liquid phase (Băducă et al., 2000).

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2. MATERIALS AND METHODS

Grapes of Cabernet Sauvignon red wine from Drăgăşani Vineyard were used as raw material, which were subjected to the fermentation maceration process in thermostatic rotary tanks (Ţârdea, 2007).
The following operations have been successively realised:

- Filling containers at 80% capacity;
- Sulfitation of grape pulp with 100 mgSO_2 / kg grape;
- Fermentation - maceration at different temperatures: 25°C, 30°C, 35°C;
- Rotating the tank in scheme 2 x 5 min/h;
- Interruption of maceration after achieving the maximum colouring intensity;
- Separation of fractions.

The liquid phase of pulp grapes was used for analysis, from 6 in 6 h. They were analysed:

- colour tint and colour intensity: spectrophotometrically, expressed in optical density OD measured at 420 nm + 520 nm in 1 mm cuvettes (Tiţa, 2006a);
- anthocyanins: spectrophotometrically, at 520 nm, expressed in mg/l (Ţârdea, 2007);
- total polyphenols: titrimetric by the method potassium permanganate index, expressed in g/l (Tiţa, 2006a).

At 6 months after fermentation, a series of analyses were undergoing on wines **:**

- Sugar initially and at the end of maceration: refractometry expressed in g/l (Tiţa, 2006a).;
- Total SO_2: titration with iodine, expressed in mg/l (Tiţa, 2006a);
- Alcohol: alcoholmetriy method, expressed in vol% (Tiţa, 2006a);
- Total acidity, titration with NaOH 0,1n, expressed in g/l (H_2SO_4) (Tiţa, 2006a);
- Volatile acidity, titration the distillate with NaOH 0,1n, expressed in g/l (H_2SO_4) (Tiţa, 2006a);
- Reducing extract, by extractoenometry method, expressed in g/l (Ţârdea, 2007);
- Ash: gravimetric method, expressed in g/l (Ţârdea, 2007);
- Acetaldehyde, chemical volumetric method, expressed in mg/l (Ţârdea, 2007);
- Total polyphenols, titration with $KMnO_4$, expressed in g/l (Tiţa, 2006a);
- Anthocyanins: spectrophotometrically, at 520 nm, expressed in mg/l

(Ţârdea, 2007);

- Colour tint and colour intensity: spectrophotometrically, expressed in optical density OD measured at 420 nm + 520 nm in 1 ml cuvettes (Tiţa, 2006a).

3. RESULTS AND DISCUSSION

Maceration temperature conditions greatly influence the evolution of alcoholic fermentation, contributing effectively to the destruction of the husks cell walls, solubilisation and diffusion of phenolic compounds.
The evolution of the anthocyanins presented in Figure 1 highlights an extraction dynamics which is more alert as maceration temperature is higher.

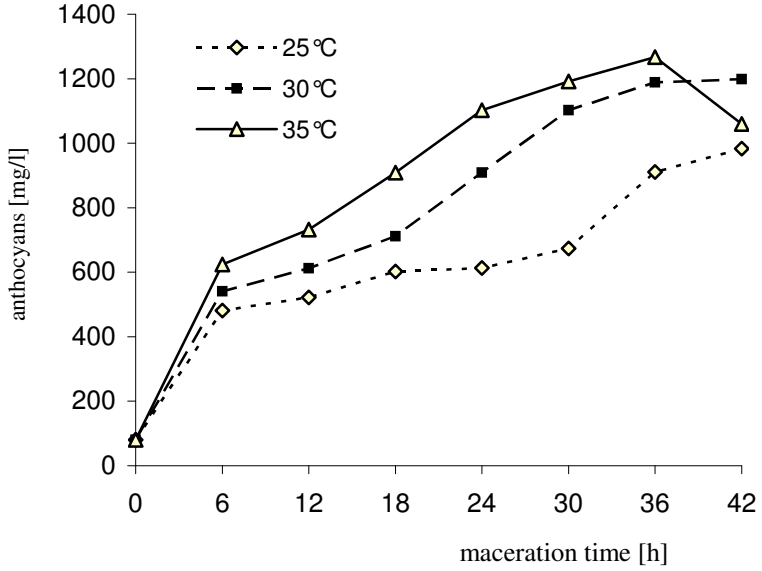

Figure 1: The evolution of the anthocyan during maceration at different temperatures

The same content of anthocyanins (910 mg/kg) is achieved after 18 hours at 35°C, after 24 hours at 30°C and after 36 hours at 25°C. At higher temperatures (30°C to 35°C) the rate of anthocyanins extraction is high and held constant since the beginning of maceration up to 36 hours of maceration, when the maximum is achieved. At lower temperature (25°C), the extraction dynamic is different, slower as at higher temperatures in the

first 24 hours; then, the anthocyanins content increases by the end of maceration.
The analysis of the values of anthocyanins extracted after 36 hours of maceration at different temperatures (25°C, 30°C, respectively 35°C) indicates the following values: 910, 1190 and 1240 mg/l, which correspond to the content in unfermented sugars of 124 g/l, 68 g/l, respectively 43 g/l. So, the anthocianins content can be correlated with the sugars consumed by alcoholic fermentation.
The evolution of the colouring intensity (presented in Figure 2), in the same conditions of maceration, is generally similar to that of anthocyanins. The maximal colour intensity at maceration at 35°C is achieved after only 12-18 hours; similar values are obtained after maceration for 30-36 hours at 30°C and for 42 hours at 25°C. Maximum dye intensity values is found after a period of maceration equivalent to 18 hours at 35°C, after 36 hours at 30°C and above 42 hours at 25°C, corresponding to 130 g/l, 70 g/l and 30-40 g/l unfermented sugar.

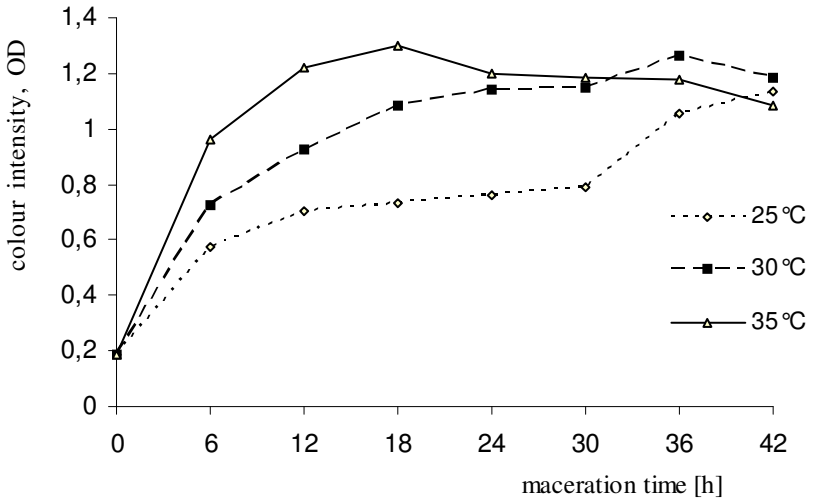

Figure 2: The evolution of the coloring intensity during maceration at different temperatures

The evolution of the tint colouring shows, as presented in Figure 3, its decreasing between 6 and 30 hours of maceration, lower values being obtained for maceration at higher temperatures. After that, the variation with the maceration temperature is more or less significant.

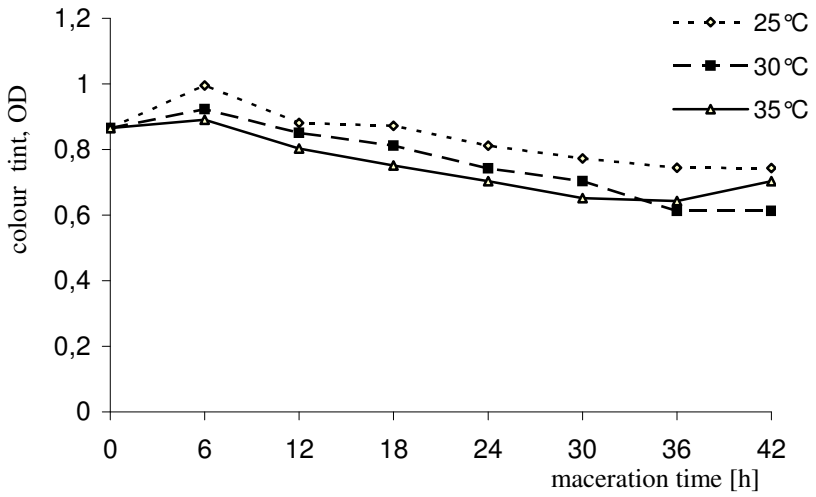

Figure 3: The evolution of the coloring tints during maceration at different temperatures

As presented in Figure 4, the evolution of the polyphenols evidences the increase of polyphenols contents in direct correlation with the levels of temperature. A slight decrease at 24 hours of maceration is observed.
Maceration at 35^{o}C ensures the maximum extracted polyphenols after 36 hours, whereas at other temperature the polyphenols content continues to increase with the maceration time.

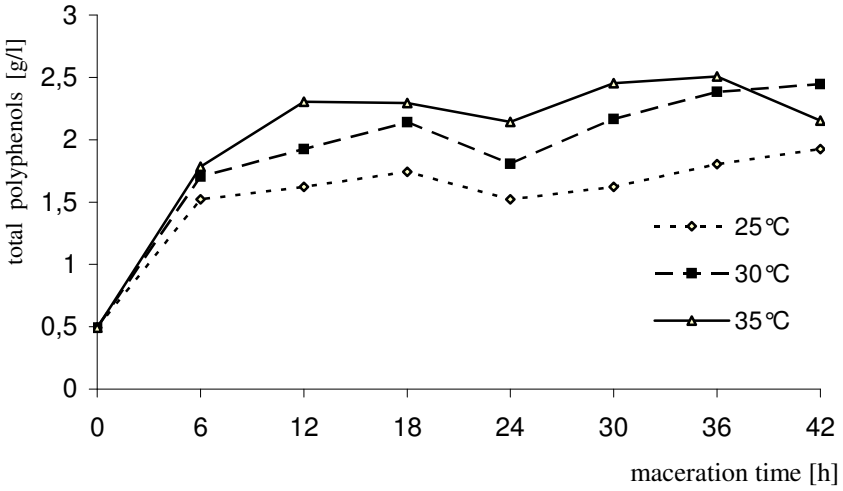

Figure 4. The evolution of the total polyphenols during maceration at different temperatures

Maceration time plays also a very important role. As Figures 1, 2 and 3 show, the better anthocyanins, colouring agents and polyphenols extraction is obtained when maceration time is around 36 h; the increase of the maceration time don't improve these characteristics.
In Table 1 the influence of heat treatment during the fermentation maceration process is presented, for wines analysed after 6 months of obtaining.

Table 1: The characteristics of the wines analyzed at 6 months after obtaining

Nr. crt.	**Characteristics**	**Maceration temperature, °C**		
		25	***30***	***35***
1	Sugar initially, g/l	198	198	198
2	Maceration duration, hours	42	42	42
3	Sugar at the end of maceration, g/l	90	45	15
4	Total SO_2, mg/l	41	41	35
5	Alcohol, vol%	11,8	11,8	11,8
6	Total acidity, g/l (H_2SO_4)	3,82	3,57	3,43
7	Volatile acidity, g/l (H_2SO_4)	0,37	0,39	0,44
8	Reducing extract, g/l	27,4	28,4	29,2
9	Ash, g/l	3,05	3,15	3,36
10	Acetaldehyde, mg/l	16	8	2
11	Total polyphenols, g/l	1,700	2,060	2,170
12	Tannins polyphenols, g/l	0,500	0,740	0,780
13	Anthocyanins, mg/l	495	610	630
14	Colour intensity, OD	1,05	1,26	1,24
15	Colour tint, OD	0,481	0,470	0,479

Quantitative values of many constituents are present either in direct correlation (volatile acidity, extract, ash, total polyphenols and tannins, anthocyanins or in a negative correlation (total acidity, acetaldehyde) with the temperature. Colouring intensity shows clearly higher values in higher temperatures, which is correlated with the anthocyanin content of wines. Tint colouring are within close slightly lower levels were recorded again to higher temperatures.

4. CONCLUSIONS

Maceration tanks thermal regime in rotating metal thermostat is a factor of prime importance in the development process and achieves optimal colour and composition parameters for red wines.

Under the influence of temperature, anthocyanic pigments pass to the liquid phase; higher temperatures allow a better extraction of pigments into the liquid, well correlated with the increase of colour intensity in wine. Also, the extraction of polyphenols is etter achieved at higher temperatures.
The research revealed that the thermal conditions with maximum efficiency are between 30 and 35^{o}C.

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