COMPARATIVE STUDY ON THE INFLUENCE OF MACERATION TECHNOLOGY ON THE RED WINES PHENOLIC COMPOUND

STUDIU COMPARATIV PRIVIND INFLUENȚA TEHNOLOGIILOR DE MACERAȚIE ASUPRA COMPUȘILOR FENOLICI DIN VINUL ROȘU

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Abstract. *The aim of this paper is to study the influence of various types of maceration technology on the red wines phenolic compounds, because of their positive effects on human health. Experimental material used: Băbească neagră grapes was harvested from Cetățuia hill and Fetească neagră from the V. Adamachi farm, harvested in 2010. The wines content of phenolic compounds varied, depending on the technological variant (classical maceration, rotating tank maceration, thermo-maceration and microwave maceration). Following the vinification, eight technologic variants were obtained and also physical-chemical parameters, antiradical activity, D280 index and IFC indices were determined. The quantity of anthocyans and phenolic acids in wines, obtained from grape variety Băbească neagră and Fetească neagră, was determinated by liquid chromatography. The analyses prove that there are quantifiable variations of the phenolic compounds depending on the type of maceration, a high efficiency in extraction of phenolic compounds being registered in thermo-maceration for both grape varieties.*
Key words: *red wines, technological variants, phenolic compounds*

Rezumat. *Obiectivul acestui studiu îl reprezintă influența diferitelor tipuri de macerare asupra compușilor fenolici din vinurile roșii, datorită beneficiilor asupra sănătății omului. Materialul experimental folosit a fost preluat din zona Cetățuia-Băbească neagră și de la ferma Adamachi-Fetească neagră, în anul de producție 2010. Vinurile au un conținut ridicat în compuși fenolici, funcție de varianta tehnologică (macerarea clasică, macerarea- fermentare în cisterne rotative, termo-macerarea și macerarea cu microunde). În urma vinificării s-au obținut opt variante tehnologice, iar la vinul obținut s-au determinat parametrii fizico-chimici, D280, IFC. Cantitatea de antociani și de acizi fenolici ale vinurilor obținute din soiurile Băbească neagră și Fetească neagră a fost determinată prin tehnica lichid cromatografie. În urma analizelor efectuate s-au observat variații ale compușilor fenolici în funcție de tipul de macerare, astfel o eficiență ridicată în extracția compușilor fenolici a avut-o termomacerația pentru ambele soiuri.*
Cuvinte cheie: *vinul roșu, variante tehnologice, compuși fenolici*

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INTRODUCTION

Red wines are a rich source of different phenolic compounds, which contribute sensorial characteristics (astringency, colour and bitterness as well as ageing ability) to the wines and can exhibit antioxidant properties. Many researches have suggested that polyphenolic compounds present in wine may play a protective role in diseases believed to involve, in part, oxidation, such as coronary heart disease, inflammation and carcinogenesis (Lopez-Velez et. al., 2003).

The growing season, variety, environmental and climatic conditions, plant disease, cultivar, viticulture practices, vinification techniques, soil type, geographic locations and even maturity seem to influence the concentration of phenolic compounds within the same fruit type. Some of the winemaking techniques have been reported to increase phenolic concentration: thermo-maceration and must freezing. In contrast, sulphite and cold maceration have frequently been shown to have a decrease in phenolic levels (Sacchi et. al., 2005).

The aim of this study represents the influence of maceration technology in some red wines phenolic compounds.

MATERIAL AND METHOD

The wines analyzed were obtained from Băbească neagră and Fetească neagră varieties. The grapes were harvested at technological maturity from Cetățuia hill and V. Adamachi, Iași farms.

Different technological variants of maceration were performed: classical (code –V1), rotating tank (code-V2), thermo-maceration (code–V3) and microwave maceration (code –V4).

Classical and rotating tanks versions had a maceration period of 5 days before end-test of maceration (skin colour invariants during maceration fermentation). At the thermo-maceration option the working temperature was 70 °C for about 30 minutes and in the microwave tests the samples were treated to 750 W for 15 minutes.

After its alcoholic fermentation, the wine was racked at room temperature for conducted malolactic fermentation. After 7-8 days the wine was sterile filtered and bottled with the help of an Enomatic Tenco device. Immediately after adding a dose of sulfur dioxide by 40 mg/L per bottle, they were corked with a Mini TS.

At 6 months after bottling wine samples were analyzed for determining the basic physico-chemical parameters (alcohol strength (% vol.), total acidity (g/L $C_4H_6O_6$), volatile acidity (g/L $C_2H_4O_2$), relative density at 20 ^{O}C, reducing sugar (g/L), total dry extract (g/L), non-reductive extract (g/L), free and total sulfur dioxide (mg/L), but also of parameters specific phenolic compounds.

The analytical methods used to characterize the above parameters are in accordance with European standards and stipulated by the OIV.

In order to characterize phenolic compounds have realized a series of spectrometric measurements to evaluate the total polyphenolic index, Folin-Ciocâlteu index, total anthocyanins by pH variation method. Photometric measurements were made using Analytik Jena S200 spectrometer.

For analysis of phenolic acids and other phenolic compounds in wine we have been using monolithic separation columns (Castellari et al., 2002) and samples were processed on a Shimadzu HPLC.

RESULTS AND DISCUSSIONS

The physical-chemical analyses of Băbească neagră and Fetească neagră wines obtain by applying the four fermentation maceration technologies are presented in Table 1.

In case of wines Băbească neagră the lower alcoholic strength presents the variants obtained by microwave maceration (V4-BN-m), 11.26% vol, and the highest concentration of 11.42% vol. variant by thermo-maceration (V3-BN-t). Lowest value recorded in the Fetească neagră rotating tank maceration (V2-FN-r), 13.27% vol. and the highest classical and thermo-maceration variant of 13.67% vol. (V1-FN-c and V3-FN-t).

In determining the total acidity, the results range from 5.02 g/L tartaric acid (V1-BN-c) and 5.99 g/L tartaric acid (V4-BN-m) the variety Băbească neagră, and the Fetească neagră values are much higher and ranged between 7.42 g/L tartaric acid (V4-FN-m) and 9.44 g/L tartaric acid (V2-FN-r).

As regards the volatile acidity are observed higher values for variants obtained from Fetească neagră variety: from 0.22 g/L for V2-FN-m to 0.33 g/L for other options. The variety Băbească neagră, the minimum is 0.27 g/L, recorded in V2-BN-r, and the maximum value at V1-BN-c, of 0.33 g/L.

The highest values at free SO_2 and total SO_2 were identified in Fetească neagră variety, SO_2 content thus demonstrating its protective role against oxidation wines.

Total SO_2 content of the maximum values in V4-BN-m Băbească neagră variety 52.10 mg/L and V1-FN-c,V3-FN-c-t for Fetească neagră variety 72.20 mg/ L. Minimum total SO_2 was determined for V2-BN-r value of 37.78 mg/L.

Red wines that are rich in phenolic compounds (anthocyanins and tannins) are characterized by a power superior antioxidant vitamins C and E (Vinson et. al., 1995).

In terms of composition anthocyanins were identified 9 anthocyanins in each wines sample (Băbească neagră and Fetească neagră): Dp–delphinidin; Cy–cianidin; Pt–petunidin; Po–poenidin; Mv–malvidin; Po-a-poenidin acetylated, Mv-a-malvidin acetylated; Po-cm-poedinidin cumarilated and Mv-cm-malvidin cumarilated (Table 2).

In grapes, musts and wines malvidin constitutes the most part of anthocyanins, as observed in table 2. In case Băbească neagră varietal highest percentage of total anthocyanins was obtained from the classical maceration with a value of 86.43 %, while at Fetească neagră at rotating tank maceration, with a higher value of 94.24 %.

Table 1

Main content characteristics Băbească neagră and Fetească neagră variety 2010

Technological variants	Physical-chemical characteristics								
	Alcohol strength (%)	Total acidity (g/L $C_4H_6O_6$	Volatile acidity (g/L $C_2H_4O_2$)	Relative density (g/cm^3)	Reductive sugar (g/L)	EST (g/L)	EN (g/L)	Free SO_2 (mg/L)	Total SO_2 (mg/L)
Băbească neagră									
Classical maceration (V1-BN-c)	11.34	5,02	0.33	0.99346	2.67	21.6	18.93	7.92	42.04
Rotating tank maceration (V2-BN-r)	11.27	5.14	0.27	0.99331	2.28	22.4	19.72	7.01	37.78
Thermo-maceration (V3-BN-t)	11.42	5.44	0.28	0.99434	3.28	24.5	21.59	12.8	47.22
Microwave maceration (V4-BN-m)	11.26	5.99	0.29	0.99475	2.44	24.8	22.57	10.66	52.10
Fetească neagră									
Classical maceration (V1-FN-c)	13.67	8.98	0.33	0.99884	3.77	42.8	38.53	12.19	72.20
Rotating tank maceration (V2-FN-r)	13.27	9.44	0.33	1.0006	4.04	45.7	41.84	28.33	64.28
Thermo-maceration (V3-FN-t)	13.67	8.31	0.33	0.996794	3.77	42.3	38.53	12.19	72.20
Microwave maceration (V4-FN-m)	13.31	7.42	0.27	0.99587	2.77	34.6	31.83	18.58	57.88

EST(g/L)-Total dry extract; EN(g/L)-Non-reductive extract

Table 2

Percentage values (% of amount) of the 9 anthocyanins in Băbească neagră and Fetească neagră 2010

Technological variants	The quantity of anthocyanins(%)										
	Dp	Cy	Pt	Po	Mv	Po-a	Mv-a	Po-cm	Mv-cm	ΣAnt.	ΣAnt./Mv
Băbească neagră											
Classical maceration (V1-BN-c)	1,04	0,04	3,53	3,12	78,69	1,13	11,42	0,03	0,99	86,43	9,84
Rotating tank maceration (V2-BN-r)	0,94	0,06	2,86	2,79	76,16	1,28	10,80	0,62	4,48	82,81	8,74
Thermo-maceration (V3-BN-t)	1,82	0,13	3,81	4,40	69,94	1,48	10,67	1,19	6,56	80,10	14,53
Microwave maceration (V4-BN-m)	1,32	0,13	3,47	4,49	73,53	1,46	10,50	0,66	4,44	82,94	12,80
Fetească neagră											
Classical maceration (FN-c)	0,98	0,00	0,43	27,07	62,14	1,58	1,11	3,45	3,24	90,63	45,84
Rotating tank maceration (V2-FN-r)	0,19	1,74	0,34	27,12	64,84	1,01	1,62	1,03	2,10	94,24	45,34
Thermo-maceration (V3-FN-t)	5,29	0,50	9,25	8,11	65,46	0,67	2,94	1,92	5,86	88,61	35,36
Microwave maceration (V4-FN-m)	2,71	0,25	6,56	6,83	73,35	0,56	2,75	1,70	5,28	89,70	22,29

ΣAnt.- the amount of the anthocyans; ΣAnt./Mv-report of the amount of anthocyans and malvidin;

In figures 1 are presented content of total phenolic compound (D280) and IFC, where it can be seen that in both varieties maximum value of phenolic compounds was obtain at variant V3 (thermo-maceration), which confirms this methods of maceration is recommended for extracting a high content of phenolic compounds from grapes.

In figure 2 are represented total quantity of anthocyanins (mg/L).Graphical distribution of the evaluation of the figure it can be said that the thermal variations (indexed V3-BN-t and V3-B-FN-t-t) are the large amounts of anthocyanins, share of anthocyanins depends on grape variety which originated wine.

Anthocyanins concentration varies from minimum of 202.79 mg/L at V2-BN-r samples and 172.55 mg/L at V2-FN-r at maximum values of 316.85 mg/L for V3-BN-t and 296.62 mg/L for V3-FN-t.

From comparing data the two figures (1 and 2) it is noted that the highest amount of phenolic compounds and anthocyanins obtained by thermo-maceration for both variety Fetească neagră and Băbească neagră.

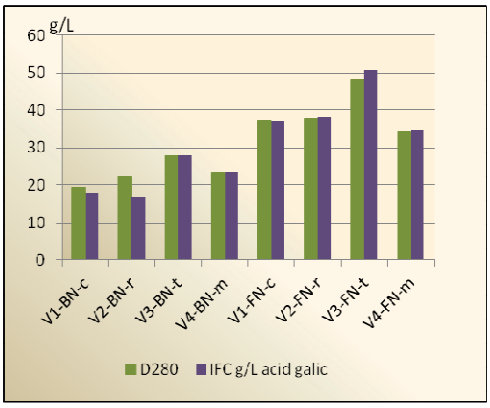

Fig. 1-Index D280 and Folin –Ciocâlteu

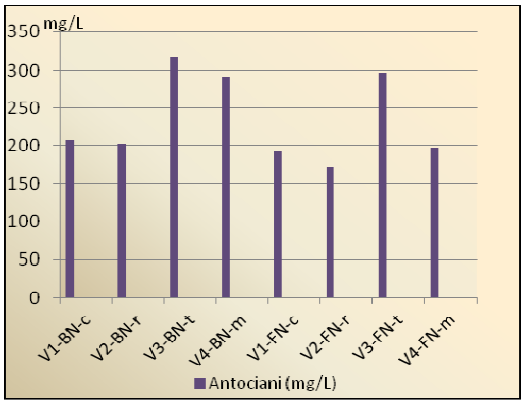

Fig. 2-Total quantity of anthocyanins

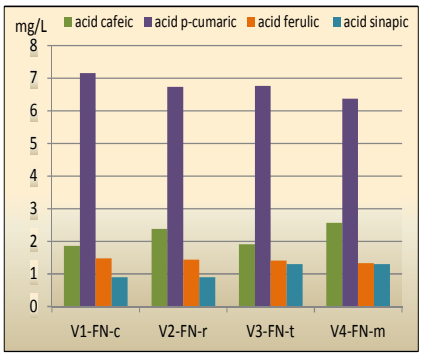

Fig. 3-Values distribution for hidroxicinamics acid at wines Fetească neagră

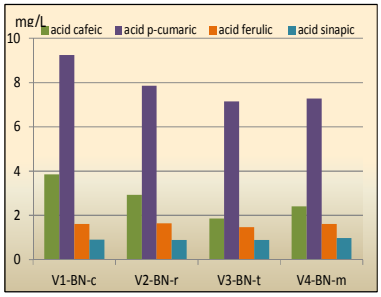

Fig. 4-Values distribution for hidroxicinamics acid at wines Băbească neagră

As can be seen from figures 3 and 4, the values of *p*-coumaric acid are higher in both varieties Fetească neagră and Băbească neagră, in each technological variant, it is important for the protection of wine against oxidative factors. Caffeic, ferulic and sinapic acid have values approximately equal in the two varieties and technological variants.

It is noticed that technological variants have very similar values, so these sample are not influenced by technological factors.

CONCLUSIONS

1. From the data obtained from these experiments we conclude that both in variety Băbească neagră and Fetească neagră maximum of phenolic compounds and anthocyanins obtained by thermo-maceration variants, which confirms this method of maceration is recommended for extracting a high content of phenolic compounds from grapes.

2. As regards of composition anthocyanins were identified nine anthocyanins in each wine sample, malvidina constituting the highest amount of anthocyanins.

3. In terms of representing the values distribution of hidroxicinamics acids is observed that technological variants have relatively equal values, so this paramenter is not influenced by technological factors.

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