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STUDIES ON SOME STILL WINES OBTAINED BY THE *BLANC DE NOIRS* METHOD

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ABSTRACT. Consumer interest in innovative wines has increased in recent years in Romania, in correlation with the development of the wine sector. Nowadays, the winemaking technique proposed by Dom Perignon (*blanc de noirs*) with applicability to sparkling wines is increasingly used to obtain still wines. This research aimed to identify the most suitable technology for obtaining white wines from Fetească neagră and Busuioacă de Bohotin grapes. The resulting wines were analysed from physical-chemical and chromatic points of view, and their sensory properties and volatile compounds content were also registered. The obtained samples had characteristics usually found in wines obtained from white grape varieties. Although frequently used in the production of base wine for sparkling wines, this technique can give original results in obtaining still wines as well. The use of activated carbon has led to the production of wines with a higher commercial value (improved colour characteristics). Given that red wines are significantly less consumed compared to white ones, this technique allows the use of black grape varieties and the production of innovative white wines.

Keywords: *blanc de noirs*; Busuioacă de Bohotin; Fetească neagră; winemaking.

INTRODUCTION

Busuioacă de Bohotin and Fetească neagră varieties are among the most appreciated varieties in Romania. The unique aroma of Busuioacă de Bohotin (roses, basil, wild strawberries) (Tarțian *et al.*, 2017) and Fetească neagră grapes (intense aromas of black berries, with soft nuances of dark chocolate) is the

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main reason why they are among the most consumed locally.

Busuioacă de Bohotin originates from Greece and it has the prime name of *Muscat à Petits Grains Rouges* according to the Vitis International Variety Catalogue (variety number: 8238). This grape is usually used to obtain rosé wines, two valuable clones being used in Romania: Busuioacă de Bohotin - 26 Pt and Busuioacă de Bohotin - 5 IS. Fetească neagră is considered a Romanian grape variety, having the variety number 4120. Red and rosé wines are usually obtained from this variety.

Inspired by Dom Perignon's method of obtaining white wines (Cotea *et al.*, 2005) from red grapes, the *blanc de noirs* method involves quick processing of the grapes before the colour pigments stain the mesocarp. By eliminating the maceration process, the final result is practically a different wine with unclear potential. Although the method has been known for a long time, it is little applied in Romanian winemaking processes and there are few studies that refer to the quality of these wines. There is no research, to our knowledge, regarding the quality of Fetească neagră and Busuioacă de Bohotin wines obtained by the mentioned technology.

MATERIALS AND METHODS

The experimental protocol was employed to produce four variants of white wines from Busuioacă de Bohotin and Fetească neagră grapes. The grapes were destemmed and crushed so that a gravitational flow must was released. The two obtained musts were subjected to a clarification process through gravitational settling. Each must was then divided into two aliquots.

One variant of each variety was treated with 1 g/L activated charcoal, according to the International Code of Oenological Practices (OIV, 2022) to eliminate the colour pigments. After 24 h, the musts were filtered. Each variant was inoculated with *Saccharomyces cerevisiae* yeast (Zymaflore® RX60, Laffort) at a dose of 20 g/hL (in accordance with the manufacturer's recommendations). The alcoholic fermentation took place at 10 - 12 °C, for about 3 weeks. Then the samples were processed similarly for each variant. A sulphur dioxide treatment was administered (6 % concentration) at a dose of 1.5 mL/L before the filtration process. The obtained wine was bottled, corked and labelled. The samples were noted as follows: V1 – Busuioacă de Bohotin white wine; V2 – Busuioacă de Bohotin white wine, treated with activated charcoal; V3 – Fetească neagră white wine; V4 – Fetească neagră white wine, treated with activated charcoal.

The samples were stored at 8 °C in the dark and analysed after 3 months.

Physical-chemical properties

Physical-chemical determinations were performed according to the International Organization of Vine and Wine Compendium methods of analysis (OIV, 2022) and refer to: alcoholic strength (% vol.; OIV-MA-AS312-01B); residual substances (g/L; OIV-MA-AS311-01A); total acidity (g/L tartaric acid; OIV-MA-AS313-01); density (OIV-MA-AS2-01B); free and total sulphur dioxide (mg/L; OIV-MA-AS323-04B); and total dry extract (g/L; OIV-MA-AS2-03A).

Chromatic parameters

The chromatic parameters were analysed using a Specord UV-VIS spectrophotometer, by applying the CIELab 76 method (OIV, 2022). The method proposes a wavelength, λ, of between 300 and 800 nm. Based on human eye perception, this method reduces a 3-dimensional space (coordinates **L***, **a*** and **b***), **L*** representing the vertical axis, 0 being totally opaque and 100 fully transparent. The red to green spectrum is represented by 'a+' to 'a–' and from yellow to blue the parameter 'b+' to 'b–' (Rolle *et al.*, 2007).

Sensory description

The sensory characterization of the resulting samples was done by a panel of ten people (5 men, 5 women), in accordance with the method proposed by the IUO (International Union of Oenologists). The sensory descriptor intensities were evaluated with scores from 0 to 10 and the means of all results were calculated (Moroșanu *et al.*, 2018).

Volatile compound quantification

Separation and quantification of the volatile compounds was done using a headspace Agilent Technologies 7890B GC System with flame-ionization detection. Before the injection, the wine samples were centrifuged at 10,000 rpm for 5 min.

The conditions required for this method are: an increase in temperature from 25 °C to 250 °C in 5 °C/min increments. The entire analysis lasted 55 min, with scanning being done between 30 *m/z* and 200 *m/z*, with the detector sensibility at 1.0 kV, and 50 *m/z* to 200 *m/z*, with the detector sensibility at 1.1 kV (Colibaba *et al.*, 2015).

Statistical tests

Data were analysed by one-way ANOVA using the online Free Statistics Calculators, version 4.0. Samples were analysed in triplicate.

RESULTS AND DISCUSSION

Physical-chemical properties

The physical-chemical characteristics of the samples are presented in *Table 1*. The obtained wines were dry, with 1.6–1.7 g/L reducing substances and an alcoholic strength of between 11.2 and 12.5 % vol. The physical-chemical results showed significant differences between all samples, the exception being V1 and V2 reducing sugar values ($p > 0.05$).

Although activated charcoal has the ability to absorb some toxic fatty acids that can interfere with the fermentation process (Lafon-Lafourcade *et al.*, 1984), sample V4 contained a higher content of reducing sugars (1.7 ± 0.01 g/L), indicating a slower fermentation rate (Cotea *et al.,* 2009). The samples treated with activated charcoal (V2 and V4) showed lower values of alcoholic strength, total acidity and total dry extract in comparison with their controls.

The analysed wines presented a lower total dry extract for Busuioacă de Bohotin wines (17.3 ± 0.00 g/L for V1 variant and 16.4 ± 0.01 g/L for V2) than for those made with the Fetească neagră variety (19.0 ± 0.01 g/L for V3 sample and 17.8 ± 0.00 g/L for V4). The values were similar to those obtained by other authors for white varieties. For example, Scutarașu *et al.* (2019) obtained values between 17.7 and 24.8 g/L for total dry extract in Fetească regală wines from Copou-Iași vineyard. Călin *et al.* (2019) presented 31.3 g/L for Busuioacă de Bohotin (rosé wine) and 25.5 g/L for Muscat Ottonel, also obtained in Copou-Iași vineyard.

Chromatic parameters

The chromatic parameters of the analysed samples are presented in *Table 2.* The main difference was caused by the utilization of activated charcoal, for both varieties.

The **L*** clarity parameter indicates the quantity of light that a surface seems to generate (De Beer *et al.*, 2006). In other words, this parameter measures the variation from dark to light. This parameter showed similar values for all samples (98.4–99.5), similar values usually being reported in the literature for white wines. The administration of activated charcoal generated significant differences between Fetească neagră samples, and no differences in Busuioacă de Bohotin ones. Regarding Busuioacă de Bohotin samples, the V1 variant was characterized by more red and blue pigments than green and yellow ones. For these samples, the activated charcoal determined a significant improvement in chromaticity, **a*** (negative value).

Busuioacă de Bohotin samples presented different amounts of ethyl acetate, these values being influenced by the technology applied (60.26 mg/L for V1 and 33.40 mg/L for V2). Regarding Fetească neagră wines, V3 registered 37.96 mg/L for this compound, while V4 showed 37.42 mg/L ethyl acetate. In correlation with data presented by Lăcureanu *et al.* (2012), this compound is usually found in high amounts in Busuioacă de Bohotin wines.

Saturation, **C***, is a parameter based on the chromatic ones (**a***, **b***), representing the quantity of pure colour present in the wine (De Beer *et al.*, 2006). The values registered for the analysed wines were between 1.26 and 3.54. Variants treated with activated charcoal showed significantly ($p < 0.05$) smaller values for both parameters. According to data presented by Zamfir *et al.* (2009), the **L*** parameter was 71.51 for Busuioacă de Bohotin rosé wine and 25.51 for Fetească neagră red wine.

The **a*** parameter represents the green–red spectrum while **b*** indicates the blue–yellow spectrum. This indicator presented higher values for Fetească neagră wines (3.43 ± 0.02 in V3 variant; 1.78 ± 0.02 in V4).

In comparison with some red wines obtained from the same geographical region, Cotea *et al.* (2005) highlighted values of around 24.5 for Fetească neagră red wines.

Evaluation of volatile compounds

Seven volatile compounds were analysed: acetaldehyde, ethyl acetate, isoamyl acetate, ethyl lactate, 1-propanol, 2-methyl 1-propanol and 1-butanol. The results are presented in *Table 3*.

Acetaldehyde is usually obtained during the fermentation phase and gives the wine a distinct odour of green fruits (Nașcu *et al.*, 2006). Its values varied between 40.48 mg/L and 43.51 mg/L (*Table 3*) for Busuioacă de Bohotin wines, while for Fetească neagră, values between 24.47 mg/L and 24.89 mg/L were registered.

Isoamyl acetate and ***ethyl lactate*** are generally formed during the fermentation phase, by combining organic acids with alcohols and organic esters (Delfini *et al.*, 2001). Ethyl acetate is responsible for a fruity odour, such as that of pears (Colibaba *et al.*, 2015). Isoamyl acetate is usually found in young wines, being responsible for a banana flavour (Clarke *et al.*, 2004). During the maturation stage, the concentrations of this compound are generally diminished (Cotea *et al.*, 2009).

Table 1 – Physical-chemical parameters

Sample	Alcoholic strength (% vol.)	p-value – by groups	Reducing substances (g/L)	p-value – by groups	Free sulphur dioxide (mg/L)	p-value – by groups	Total sulphur dioxide (mg/L)	p-value – by groups	Total acidity (g/L tartaric acid)	p-value – by groups	Total dry extract (g/L)	p-value – by groups
V1	11.2 ± 0.01	0.0000	1.7 ± 0.03	0.0590	10 ± 0.01	0.0000	107 ± 0.01	0.0000	6.7 ± 0.00	0.0000	17.3 ± 0.00	0.0000
V2	11.0 ± 0.02		1.6 ± 0.02		5 ± 0.01		96 ± 0.00		6.2 ± 0.01		16.4 ± 0.01	
V3	12.5 ± 0.00	0.0000	1.7 ± 0.01	1.0000	15 ± 0.00	0.0000	131 ± 0.01	0.0000	6.9 ± 0.01	0.0000	19.0 ± 0.01	0.0000
V4	12.1 ± 0.01		1.7 ± 0.01		6 ± 0.01		70 ± 0.00		6.3 ± 0.00		17.8 ± 0.00	
***p*-value – all variants**	0.0000		0.0000		0.0000		0.0000		0.0000		0.0000	

Table 2 – Chromatic parameters

Sample	Clarity L*	*p*-value	a*	*p*-value	b*	*p*-value	Saturation/ Chroma C	*p*-value	Tonality H	*p*-value
V1	99.5 ± 0.00	1.0000	−0.11 ± 0.02	0.0000	2.03 ± 0.02	0.001	2.03 ± 0.03	0.0010	86.97 ± 0.01	0.0000
V2	99.5 ± 0.02		2.15 ± 0.00		1.26 ± 0.03		1.26 ± 0.01		89.9 ± 0.00	
V3	98.4 ± 0.02	0.0000	0.87 ± 0.01	0.0000	3.43 ± 0.02	0.0000	3.54 ± 0.01	0.0000	75.71 ± 0.01	0.0000
V4	99.3 ± 0.01		0.25 ± 0.00		1.78 ± 0.02		1.80 ± 0.03		82.07 ± 0.00	

Table 3 – Volatile compound composition

Variant	Acetalde hyde	*p*-value (by variety)	Ethyl acetate	*p*-value (by variety)	1-Pro panol	*p*-value (by variety)	2-Methyl-1-propanol	*p*-value (by variety)	Isoamyl acetate	*p*-value (by variety)	1-Bu tanol	*p*-value (by variety)	Ethyl lactate	*p*-value (by variety)
V1	40.48 ± 0.05	0.0000	60.26 ± 0.02	0.0000	35.75 ± 0.02	0.0000	23.58 ± 0.05	0.0000	5.52 ± 0.03	0.3600	1.20 ± 0.03	1.000	19.38 ± 0.04	0.0000
V2	43.51 ± 0.03		33.40 ± 0.01		19.12 ± 0.01		13.38 ± 0.02		5.49 ± 0.02		1.20 ± 0.05		12.60 ± 0.01	
V3	24.47 ± 0.01	0.0030	37.96 ± 0.03	0.0030	25.23 ± 0.04	0.0000	15.58 ± 0.02	0.0000	5.30 ± 0.01	0.001	1.26 ± 0.01	0.001	13.89 ± 0.05	0.0000
V4	24.89 ± 0.03		37.42 ± 0.03		22.18 ± 0.03		25.96 ± 0.03		4.77 ± 0.02		0.85 ± 0.01		11.80 ± 0.02	
***p*-value (all samples)**	0.0000		0.0000		0.0000		0.0000		0.0000		0.0000		0.0000	

The highest concentrations of this compound were obtained for Busuioacă de Bohotin wines (V1: 5.52 mg/L; V2: 5.49 mg/L). Generally, its levels decreased when the activated charcoal was administered.

Ethyl lactate is an ethyl ester of lactic acid, being responsible for honey odours (Waterhouse *et al.*, 1998). The highest value was registered for V1 – Busuioacă de Bohotin wine (19.38 mg/L), while the lowest was obtained in V4 – Fetească neagră variety (11.80 mg/L).

1-Propanol usually contributes to a ripe fruits flavour (Swiegers *et al.*, 2008), being identified in higher amounts in V1 – Busuioacă de Bohotin (35.74 mg/L), while the lowest concentration was obtained for V2 (19.12 mg/L). Regarding the Fetească neagră wines, V3 contained 25.23 mg/L 1-propanol and V4 presented 22.18 mg/L.

2-Methyl-1-propanol was identified in a higher quantity in the V1 sample (23.58 mg/L) for Busuioacă de Bohotin wines and V4 variety for Fetească neagră (25.96 mg/L). This compound is responsible for the solvent odour of wines (Swiegers *et al.*, 2008).

1-Butanol concentrations were not influenced by the technology administered in the first pair of samples (Busuioacă de Bohotin variety: 1.2 mg/L), while the activated charcoal generated an important reduction of this compound (V3: 1.26 mg/L; V4: 0.85 mg/L). According to Swiegers *et al.* (2008), it usually contributes to a spirituous odour.

In accordance with the gas chromatography data, the analysed varieties presented a different aroma profile ($p < 0.05$).

Administration of the activated charcoal generated a significant reduction in ethyl acetate, 1-propanol, isoamyl acetate and ethyl lactate for both varieties.

According to the results, when volatile compounds are found in small quantities (Fetească neagră samples), they are not absorbed by the activated charcoal. Similarly, Lopez (2009) reported that activated charcoal does not manifest a significant effect on volatile compound content. No papers on the application of the *blanc de noirs* technique on Romanian wines were found (Lopez *et al.*, 2009)

Sensory description of resulting wines

The olfactory and gustatory characteristics of the analysed samples are presented in *Figure 1* and *Figure 2*. Busuioacă de Bohotin samples were well structured, with a good persistence and acidity, being defined by pronounced notes of citric and exotic fruits (high levels of isoamyl acetate) as well as honey flavour (ethyl lactate).

Fetească neagră samples were underlined by an accentuated phenolic taste, being characterized by higher intensities of green fruits (acetaldehyde), fresh fruity notes (ethyl acetate) and honey.

Due to the utilization of activated charcoal, the analysed sensory descriptors were appreciated with lower notes.

Figure 3 shows the correlations between the volatile compounds identified in the samples and their sensory perception.

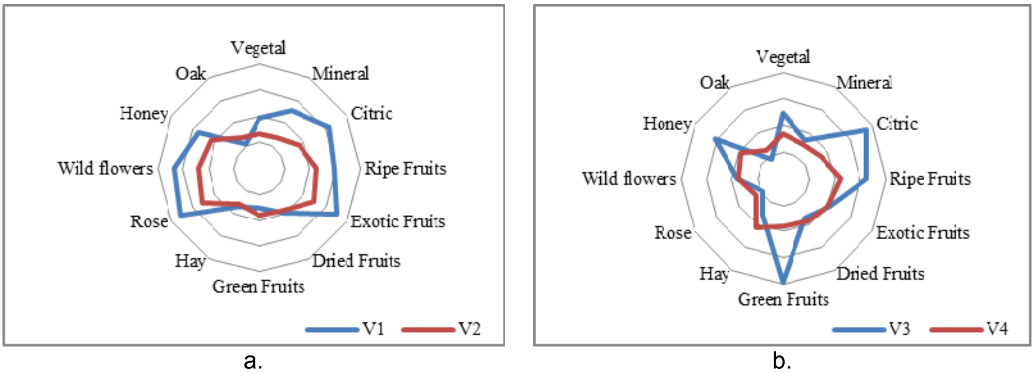

Figure 1 – Olfactory profile of Busuioacă de Bohotin (a) and Fetească neagră (b) wines

Figure 2 – Gustatory profile of Busuioacă de Bohotin (a) and Fetească neagră (b) wines

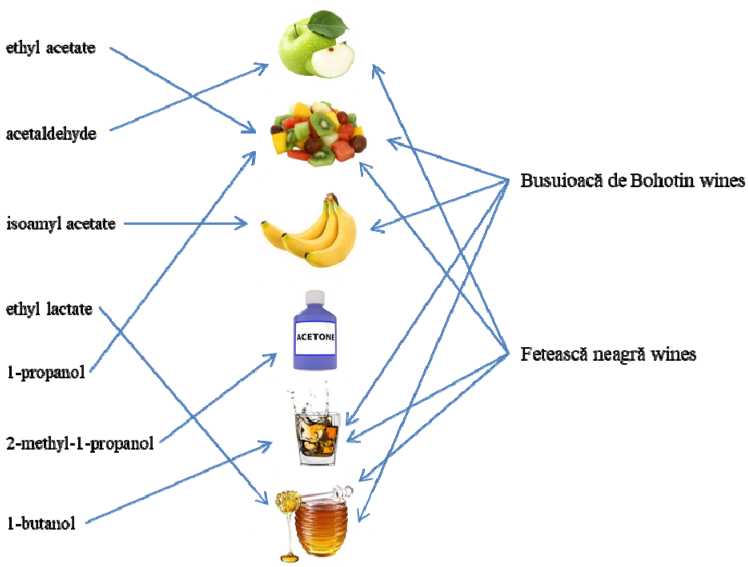

Figure 3 – Aroma profiles of analysed wines

CONCLUSIONS

The *blanc de noirs* technique can be effective for obtaining innovative still wines. The use of activated carbon induced a higher commercial value (improved colour characteristics).

The treatment also generated a significant decrease in most physicochemical parameters, reduced concentrations of the main volatile compounds and less intense aroma descriptors.

The activated charcoal can absorb larger quantities of the volatile compounds and no significant results were obtained when lower levels were found. Given that red wines are significantly less consumed than white ones, this technique allows the use of black varieties and the production of innovative white wines.

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All authors declare that they have read and approved the publication of the manuscript in this present form.

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Conflicts of Interest. The authors declare no conflict of interest.

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