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Influence of pre-fermentative treatments on the composition of 'Tămâioasă românească' and 'Aligoté' wines

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In this study a number of seven pre-fermentative treatments were conducted in order to improve the compositional characteristics of certain wines obtained from 'Tămâioasă românească' and 'Aligoté' varieties. The samples were treated with oxalic acid, lactic acid, succinic acid, tannins, bentonite, chitosan and oenological carbon. Folin-Ciocâlteu index showed that the use of pre-fermentative treatments decreased the amount of phenolic compounds from 437.93 mg/l to 195.56 mg/l, except for the wine treated with tannins where the values increased to 563.83 mg/l. Major colour and hue differences for 'Tămâioasă românească' wines are found in the samples treated with lactic acid, and for 'Aligoté' wines in case of tannin and bentonite treatments. Metal content revealed that activated carbon treatment contributed to decreasing the amount of sodium in wines. Low calcium content was found in samples treated with oxalic acid. Pre-fermentative treatments decreased the iron amount in wines from 12.99 mg/l to 3.05 mg/l.
Keywords: Wine, metal content, chromatic characteristics, AAS, pre-fermentative treatments

Einfluss präfermentativer Behandlungen auf die Zusammensetzung von 'Tămâioasă românească' und 'Aligoté' Weinen. *In dieser Studie wurden sieben präfermentative Behandlungen und deren Einfluss auf die Zusammensetzung und Charakteristik einiger Weine der Rebsorten 'Tămâioasă românească' und 'Aligoté' untersucht. Die Weine wurden mit Oxalsäure, Milchsäure, Bernsteinsäure, Tannin, Bentonit, Chitosan und Aktivkohle behandelt. Der Folin-Ciocâlteu-Index zeigt, dass Behandlungen vor der Gärung die Phenolverbindungen von 437,93 mg/l auf 195,56 mg/l reduzieren. Große Unterschiede in Farbe und anderen Inhalten wurden bei 'Tămâioasă românească' in den mit Milchsäure behandelten Varianten und für Aligoté-Weine bei einer Behandlung mit Tannin und Bentonit festgestellt. Der Metallgehalt in Weinen zeigt, dass durch den Zusatz von önologischer Aktivkohle der Gehalt an Natrium reduziert wird. Ein geringerer Calciumgehalt wurde in den Varianten mit Oxalsäurebehandlung festgestellt. Präfermentative Behandlungen reduzierten den Eisengehalt in den Weinen von 12,99 mg/l auf 3,05 mg/l.*
Schlagwörter: Wein, Metallgehalt, Farbcharakteristik, AAS, präfermentative Behandlungen

L'influence des traitements préfermentaires sur la composition des vins 'Tămâioasă românească' et 'Aligoté'. *Dans cette étude, un nombre de sept traitements préfermentaires ont été menées afin d'améliorer les caractéristiques de la composition de vins obtenues à partir des cépages 'Tămâioasă românească' et 'Aligoté'. Les échantillons ont été traités avec acide oxalique, acide lactique, acide succinique, tannins, bentonite, chitosane et carbone oenologique. Indice Folin-Ciocâlteu a démontré que l'utilisation de traitements préfermentaires ont diminué la teneur en composés phénoliques de 437,93 mg/l à 195,56 mg/l, sauf pour le vin traité avec des tanins, ou les valeurs ont augmenté à 563,83 mg/l. Les principales différences de couleur, pour les vins 'Tămâioasă românească' se trouvent dans les échantillons traités avec de l'acide lactique, et pour les vins 'Aligoté' dans le cas de traitements avec tanins et de la bentonite. La teneur en métaux a révélé que le traitement avec carbone œnologique a contribué à réduire la quantité de sodium dans les vins. Une faible teneur en calcium a été trouvé dans les échantillons traités avec de l'acide oxalique. Les trai-*

tements préfermentaires ont diminué le contenu de fer dans les vins de 12,99 mg/l à 3,05 mg/l.
Mots-clés: vin, teneur en métaux, caractéristiques chromatiques, AAS, traitements préfermentaires

In modern wine-making, besides the grape processing technology, the treatments applied to the must before fermentation also have an important role in deciding the wine's quality (Ribéreau-Gayon et al., 2006a). These have the main aim of preventing, improving or decreasing some of the faults of oxidation, excess of proteins or enzymes, etc. (Pomohaci et al., 2000). These treatments must be done in accordance with the climatic conditions of the harvest year, the quality and health state of the grapes, maturity degree and technological processes. By using these treatments adequately and at the right time, the probability of obtaining a quality product is higher (Cotea et al., 2009). Therefore the wine obtained from a treated must will need fewer future treatments than a wine obtained from a must that has not been treated in any way. Several studies have been performed on the effect of oenological practices on the wine's composition (Losada et al., 2011; Puig-Deu et al., 1996).

The increase of titratable acidity and total acidity of a wine can be achieved by lactic acid addition. Lactic acid can favour the biological evolution and maturation of wines and can also help to obtain balanced wines from a gustatory point of view (Oiv, 2013a). For increasing a must's acidity, oxalic or succinic acid can be used. Oxalic acid is also used to demonstrate the presence of calcium in a liquid as it causes turbidity and precipitation (Ribéreau-Gayon et al., 2006b). As for succinic acid, its bitter-salty taste causes salivation and accentuates the wine's flavour and vinous character (Ribéreau-Gayon et al., 2006b; Jackson, 2008).
Exogenous tannins are frequently added to wines during the winemaking process for a number of reasons: to stabilize colour, to modify mouth-feel, to mask green characters, to increase polyphenolics and aromatic stability (Harbertson et al., 2011; Parker et al., 2007).
The use of bentonite as a clarifying agent means to prevent the formation of protein haze in wines. Treating must with bentonite is recommended for wines which are to be clarified shortly after the completion of alcoholic fermentation (Ribéreau-Gayon et al., 2006a).
The treatment with chitosan can be an effective method to clarify the must and to prevent protein haze (Rao et al., 2011; Domingues et al., 2011; Oiv, 2013b). It was observed that commercial preparations of ß-glucosidase can be immobilized on chitosan and used in winemaking for the purpose of improving the aromatic potential of wines (Gallifuoco et al., 1998). Also, the use of chitosan to effectively remove the polyphenols contained in white wines with a high polyphenol content and to have a stabilization capacity comparable to that of potassium caseinate has been shown (Spagna et al., 2000).

Studies showed that chitosan can reduce the levels of iron, heavy metals (Pb, Cd) and mycotoxins (ochratoxin A) and can improve wine safety and quality (Bornet and Teissedre, 2008). According to OIV rules, only chitosan of fungal origin can be used for the purpose of fining musts.

Another clarifying agent is activated charcoal, which can be used to correct organoleptic issues of wine obtained from musts affected by fungi such as grey rot (*Botry*tis *cinerea*) or oidium (*Uncinula necator*), to eliminate possible contaminants, to reduce the metal content, to correct the color of white musts derived from the white juice of red grapes, of too yellow musts derived from white grape varieties and of oxidized musts (Ribéreau-Gayon et al., 2006b). The polyphenolic content significantly decreases following this treatment (López et al., 2001; Sen et al., 2012). Also the fining agents are responsible for eliminating some of the phenolic compounds involved in oxidation phenomena (Barón et al., 2000; Tschiersch et al., 2008; Yokotsuka et al., 2008). Knowledge of the cationic concentration in wines is of interest because of their influence on the wine-making process where metals such as potassium, calcium, iron and copper can produce precipitates or cause cloudiness (Pérez Trujillo et al., 2011; Paneque et al., 2010).

The objective of the present study is to evaluate the influence of both, different oenologically accepted, and unconventional treatments on the mineral content, phenolic content and chromatic characteristics of two white wines from 'Tămâioasă românească' and 'Aligoté' grape varieties.

Materials and methods

Reagents

Reagents for pre-fermentative treatments

Tannin (Taniblanc®) from SPINDAL-AEB Group, bentonite (Bentonita Clarit PLV 45®) from SUD-CHEMIE; oxalic acid, lactic acid, succinic acid, chitosan (high purity 93 %, from white mushroom) and activated charcoal were purchased from Sigma-Aldrich (St. Louis, USA).

Reagents for metal content

Stock solutions of each metal Na, K, Ca, Fe, Cu, Zn, were used from Merck (Darmstadt, Germany). Working standard solutions were obtained by suitable dilution from stock solution; bidistilled water was used for reagents preparation and for dilution. Cesium chloride and lanthanum chloride were purchased from Sigma-Aldrich (St. Louis, USA).

Reagents for polyphenolic compounds determination

Folin-Ciocâlteu reagent, sodium carbonate and gallic acid were purchased from Sigma-Aldrich (St. Louis, USA).

Grape samples and winemaking

Two grape varieties for white wines were used: 'Tămâioasă românească' from Cotnari vineyard and 'Aligoté' from Bucium vineyard (Romania). The grapes were harvested in 2011 at full maturity, when the grapes' composition was optimal for obtaining dry table wines ('Aligoté') and dry quality wines ('Tămâioasă românească'). After harvesting, the grapes were treated with sulphur dioxide (50 mg/kg).

The grapes were crushed and destemmed and the obtained must of each variety was divided into 8 equal batches of 45 l each and transferred into 50 l-glass vessels.
Before fermentation started, seven oenological and non-conventional products were used: oxalic acid – 0.6 g/l (V_1), lactic acid – 3 g/l (V_2), succinic acid – 2 g/l (V_3), tannins – 0.05 g/l (V_4), bentonite – 1 g/l (V_5), chitosan – 1 g/l (V_6) and activated charcoal – 1 g/l (V_7). Additionally, for each wine obtained from each grape variety, a control sample without any pre-fermentative treatment was also created (V). The glass vessels were deposited in a temperature controlled room (19 °C), where the must fermented for two weeks. No commercial yeasts were used.

After alcoholic fermentation, wines obtained from 'Tămâioasă românească' (noted with T) and 'Aligoté' (noted with A) were filtered using a filtration-filling device (Tenco Enolmatic®; Avegno, Italy), followed by sulphur dioxide addition (60 mg/l) to preserve wine from microbiological damage. Bottling was done with a semi-automatic device. Previous to sulphiting, the colour analyses were performed. After six months of storage, the rest of the compositional and specific analyses were done. In all cases, analyses were performed in triplicate, and a mean value was calculated.

Methods of analysis

Standard chemical analyses according to OIV methods

Each wine, after decarbonisation, was analysed for: sulfur dioxide (iodometry) OIV-MA-AS323-04B, volatile acidity OIV-MA-AS313-02, total acidity OIV-MA-AS313-01, alcoholic strength by frequency oscillator OIV-MA-AS312-01A, reducing substances OIV-MA-AS311-01A, pH OIV-MA-AS313-15, total dry matter and non-reducing substances OIV-MA-AS2-03B were done according to present standards (Oiv, 2013c) and specific literature (Ribéreau-Gayon et al., 2006b).

Total content of polyphenolic compounds

The total content of polyphenolic compounds was determined by the spectroscopic method Folin-Ciocâlteu using Spectrophotometer Analytik Jena S 200 (Analytik Jena AG; Jena, Deutschland) at 765 nm and was expressed in (mg of gallic acid per litre) (Singleton and Rossi, 1965, modified by Waterhouse, 2001).
Calibration curve equation was: $y = 78.693 \cdot x - 179.09$.

Correlation coefficient (R) for calibration curve was 0.9761.

Evaluation of chromatic characteristics

The wine was analysed immediately after the end of alcoholic fermentation, before sulphiting and bottling.

An Analytik Jena S 200 spectrophotometer was used to determine the chromatic characteristics according to CIELab 76 (OIV, 2013c). The CIELab76 colour or space system is based on a sequential or continuous Cartesian representation of three orthogonal axes: L, a and b. L is clarity, a is component of green/red colour and b is component of blue/yellow colour. The chromatic characteristics were calculated by equations:

$$L=116(Y/Yn)^{1/3}\quad 16 \qquad (2)$$
$$b=200\quad [(Y/Yn)^{1/3}\quad (Z/Zn)^{1/3} \qquad (3)$$
$$a=500[(X/Xn)\quad (Y/Yn)] \qquad (4)$$
$$C=(a^2 + b^2)^{1/2} \qquad (5)$$
$$H=tg\text{-}1\ (b/a) \qquad (6)$$
$$\Delta H=[(\Delta E)^2\quad (\Delta L)^2\quad (\Delta C)^2]^{1/2} \qquad (7)$$
$$\Delta E=[(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2]^{1/2} \qquad (8)$$
$$\Delta E=[(\Delta L)^2 + (\Delta C)2 + (\Delta H)^2]^{1/2} \qquad (9)$$

Metal content

The metal content was determined by Shimadzu AA-6300 Spectrophotometer (Kyōto, Japan).

Potassium and sodium

Potassium and sodium were determined directly in diluted wine by atomic absorption spectrophotometry after the addition of cesium chloride to suppress ionization of potassium and sodium. For sample preparation, 2.5 ml of wine were pipetted (previously diluted 1/10) into a 50 ml volumetric flask, and then 1 ml cesium chloride solution was added. The volumetric flask was filled up to the mark with distilled water. The used atomic absorption spectrophotometer was equipped with an air-acetylene burner and potassium and sodium hollow cathode lamps. The absorbance wavelength was set to 769.9 nm for potassium determination and 589 nm for sodium determination (Method OIV-MA-AS322-02A-Potassium, Method OIV-MA-AS322-03A-Sodium). Calibration curve equation for sodium was Abs = 0.242772 × Conc. + 0.0044680 with r = 0.9986, and for potassium Abs. = 0.080540 × Conc. + 0.041700, r = 0.9902.

Calcium

Calcium was determined directly on diluted wine by atomic absorption spectrophotometry after the addition of an ionization suppression agent. For this determination an atomic absorption spectrophotometer was fitted with an air-acetylene burner and a calcium hollow cathode lamp. For sample preparation 1 ml of wine and 2 ml lanthanum chloride solution were placed in a 20 ml volumetric flask and filled up to the mark with distilled water. The absorbance wavelength was set to 422.7 nm. Calibration curve equation was Abs. = 0.024900 × Conc. + 0.0093200, r = 0.9997 (Method OIV-MA-AS322-04-Calcium).

Iron

Iron was determined after suitable dilution of the wine and removal of alcohol directly by atomic absorption spectrophotometry. For this an atomic absorption spectrophotometer was equipped with an air-acetylene burner and an iron hollow cathode lamp. The absorption wavelength was set to 248.3 nm. Calibration curve equation was Abs. = 0.0022540 × Conc. – 0.0026000, r = 0.9884 (Method OIV-MA-AS322-05A-Iron).

Copper

For copper determination, the atomic absorption spectrophotometer was equipped with an air-acetylene burner and a copper hollow cathode lamp. 20 ml of wine were placed in a 100 ml volumetric flask and then filled up to the mark with distilled water. Absorbance was measured at 324.8 nm (Method OIV-MA-AS322-06-Copper).

Zinc

Zinc was determined directly in the wine by atomic absorption spectrophotometry at 213.9 nm after removal of alcohol. The atomic absorption spectrophotometer was equipped with an air-acetylene burner and a zinc hollow cathode lamp. Calibration curve equation was Abs. = 0.23122 × Conc. + 0.011520, r = 0.9984 (Method OIV-MA-AS322-08-Zinc). In all cases, analyses were performed in triplicate, and a mean value was calculated.

Table 1: Quality parameters of wines obtained through different pre-fermentative treatments

Wine samples	pH	Free SO_2 (mg/l)	Total SO_2 (mg/l)	Volatile acidity (g/l*)	Total acidity (g/l**)	Alcohol (% vol.)	Reductive substances (g/l)	Total dry extract (g/l)	Non-reductive extract (g/l)
TV	3.2	40	118	0.4	6.8	13.0	2.0	20.3	19.3
TV_1	3.1	26	83	0.2	7.5	12.9	1.2	20.9	19.7
TV_2	3.1	46	125	0.3	8.8	13.0	1.5	22.2	20.6
TV_3	3.2	24	79	0.2	9.9	12.9	1.1	23.5	22.3
TV_4	3.2	19	60	0.2	7.2	12.7	1.2	21.6	20.4
TV_5	3.3	14	37	0.3	6.9	12.8	1.0	20.1	19.0
TV_6	3.3	21	79	0.3	5.5	13.3	1.3	20.1	18.7
TV_7	3.1	44	103	0.2	6.6	12.6	1.1	22.4	21.3
AV	3.0	30	96	0.2	7.6	9.5	0.9	20.9	20.0
AV_1	2.9	13	51	0.2	7.9	9.9	0.8	19.3	18.4
AV_2	3.0	15	64	0.2	9.7	10.2	0.9	21.6	20.6
AV_3	3.0	43	101	0.1	8.1	9.8	0.7	20.9	20.1
AV_4	3.1	13	58	0.2	6.9	9.7	2.6	20.9	18.3
AV_5	3.1	6	36	0.2	7.0	10.1	0.6	18.3	17.6
AV_6	3.1	51	146	0.2	6.0	10.2	0.9	18.8	17.8
AV_7	3.0	13	46	0.3	5.8	9.7	0.9	19.0	18.3

* *as acetic acid*
** *as tartaric acid*

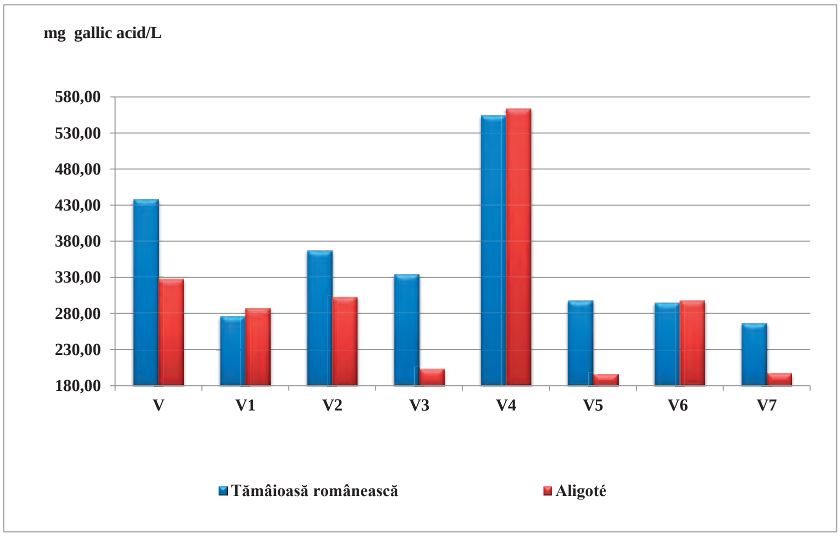

Fig. 1: Phenolic compounds index of wines (Folin-Ciocâlteu method)

Results and Discussion

Chemical analysis of wines

The volatile acidity of 'Tămâioasă românească' wines registers values between 0.2 g/l in the sample with tannin and succinic acid treatments and 0.39 g/l in the control sample, the treatment with succinic acid having a positive influence on the total acidity.

For 'Aligoté' wine, the volatile acidity values range between 0.17 g/l (AV_3) and 28 g/l (AV_7). The total acidity increases due to the addition of lactic acid. The values of the alcoholic concentration are higher in the 'Tămâioasă românească' and 'Aligoté' samples that were treated with chitosan (TV7 and AV7). Regarding the total dry extract and the non-reductive extract, the lower values are found in the samples treated with bentonite and chitosan. It was observed that the wines are dry (Table 1).

Table 2: Chromatic characteristics of 'Tămâioasă românească' wines

Tămâioasă românească wine	Clarity L	Chromaticity		Chrome C	ΔE	ΔH
		a	b			
TV	99.62	-0.54	2.28	2.34	-	-
TV_1	98.36	0.23	4.07	4.08	2.32	0.89
TV_2	99.18	-6.04	3.16	3.16	5.58	5.50
TV_3	98.50	0.47	3.88	3.91	2.19	1.06
TV_4	97.40	0.71	5.95	5.99	4.46	1.31
TV_5	97.94	0.52	5.11	5.13	3.45	1.15
TV_6	99.89	-0.44	2.03	2.08	0.38	0.04
TV_7	99.96	-0.11	0.71	0.72	1.66	0.10

Table 3: Chromatic characteristics of 'Aligoté' wines

Aligoté wine	Clarity L	Chromaticity		Chrome C	ΔE	ΔH
		a	b			
AV	98.85	-0.45	4.13	4.16	-	-
AV_1	98.73	-0.41	5.08	5.10	0.95	0.12
AV_2	98.53	-0.02	4.59	4.59	0.70	0.45
AV_3	99.38	-0.68	3.49	3.56	0.85	0.32
AV_4	97.46	0.16	0.16	6.43	4.24	3.30
AV_5	97.03	0.83	6.59	6.64	3.31	1.22
AV_6	98.81	-0.51	4.35	4.38	0.23	0.03
AV_7	99.95	-0.16	0.64	0.66	1.60	0.23

Table 4: Mean values and standard deviation of analyzed metals (mg/l) in 'Tămâioasă româneasca' (T. r.) wines

T. r.	Na	K	Ca	Fe	Zn
TV	56.86 ± 0.0014	854.38 ± 0.0034	125.48 ± 0.0047	12.99 ± 0.0025	0.90 ± 0.0016
TV_1	34.20 ± 0.0021	785.16 ± 0.0022	63.87 ± 0.0004	4.09 ± 0.0011	1.78 ± 0.0021
TV_2	65.41 ± 0.0014	763.13 ± 0.0016	160.02 ± 0.0002	4.81 ± 0.0017	1.02 ± 0.0024
TV_3	46.25 ± 0.0002	790.60 ± 0.0033	129.19 ± 0.0006	3.05 ± 0.0022	2.40 ± 0.0030
TV_4	74.63 ± 0.0020	778.49 ± 0.0014	145.06 ± 0.0015	4.03 ± 0.0030	1.23 ± 0.0028
TV_5	61.86 ± 0.0014	778.96 ± 0.0023	121.86 ± 0.0008	6.67 ± 0.0021	1.66 ± 0.0035
TV_6	80.76 ± 0.0008	819.31 ± 0.0029	66.04 ± 0.0009	3.05 ± 0.0018	1.21 ± 0.0026
TV_7	11.59 ± 0.0009	790.13 ± 0.0042	104.29 ± 0.0055	4.01 ± 0.0026	1.55 ± 0.0032

Table 5: Mean values and standard deviation of analyzed metals (mg/l) in 'Aligoté' wines

Aligoté	Na	K	Ca	Fe	Zn
AV	22.61 ± 0.0011	675.44 ± 0.0021	101.68 ± 0.0013	10.05 ± 0.0027	0.59 ± 0.0023
AV1	53.75 ± 0.0017	717.96 ± 0.0007	32.81 ± 0.0048	5.74 ± 0.0013	0.61 ± 0.0004
AV2	68.54 ± 0.0010	714.70 ± 0.0014	156.30 ± 0.0005	5.25 ± 0.0016	1.17 ± 0.0025
AV3	32.16 ± 0.0005	711.29 ± 0.0013	136.02 ± 0.0018	4.33 ± 0.0013	0.79 ± 0.0013
AV4	18.34 ± 0.0015	691.73 ± 0.0041	170.26 ± 0.0013	4.39 ± 0.0013	0.31 ± 0.0007
AV5	32.86 ± 0.0021	637.72 ± 0.0023	131.20 ± 0.0004	7.94 ± 0.0018	0.92 ± 0.0031
AV6	77.53 ± 0.0007	763.28 ± 0.0022	75.78 ± 0.0034	4.10 ± 0.0040	1.41 ± 0.0032
AV7	0.88 ± 0.0011	720.29 ± 0.0017	80.38 ± 0.0022	5.66 ± 0.0065	1.21 ± 0.0032

The variation of free and total SO_2 content in wine is mainly a result of a non-homogenous sulphiting of the grapes.
If the quantity of phenolic compounds grew after addition of tannins (V_4), in general the use of other treatments decreased the amount of these compounds (Fig. 1).

The chromatic parameters of the 'Tămâioasă românească' wines were calculated according to the CIELab 76 methods and to the registered absorption spectrum of each wine sample. The values of the L-parameter show that the wines obtained by applying chitosan and charcoal are the most clear. Generally the colour of the wines is yellow greenish (Table 2).
Major colour differences are found in the samples treated with lactic acid (TV_2), tannin (TV_4) and bentonite (TV_5), while for hue differences the biggest variation is registered in the case of lactic acid addition.
'Aligoté' wines are clearer after addition of succinic acid and activated charcoal. Major hue differences and colorimetric differences are found in the samples treated with tannin (AV_4) and bentonite (AV_5) (Table 3).

Mineral content of wine samples

With both white wines, sodium content decreased after activated charcoal addition (TV_7 and AV_7) whereas by chitosan fining (TV_6 and AV_6) the level of sodium reached the highest values. Regarding the potassium content, its level decreased after pre-fermentative treatments in 'Tămâioasă românească' wine. Due to calcium oxalate precipitation, the level of calcium significantly decreased in wines (TV_1 and AV_1). A small content of calcium was also observed in samples treated with chitosan (TV_6 and AV_6). Enological treatments applied to 'Tămâioasă românească' and 'Aligoté' wines have diminished the level of iron in wines. Small values of zinc concentration were registered in 'Aligoté' wines with oxalic (AV_1) and tannin (AV4) addition. The other treatments increased the zinc content in wines.
Copper content was below the limit of detection (SLD <0.01 mg/l) in all samples analyzed.

Conclusions

The quantity of phenolic compounds grew after addition of tannins (TV_5 and AV_5). In general, the use of other treatments decreased the amount of these compounds.
Visible colorimetric and tone difference compared to the control sample are observed in case of lactic acid addition for 'Tămâioasă românească' wines and tannin, bentonite and activated carbon fining agents for 'Aligoté' wines. Sodium content decreased after activated charcoal addition to 11.59 mg/l ('Tămâioasă românească') and 0.88 mg/l for 'Aligoté' wines.
Calcium content decreased in wine samples treated with oxalic acid, while tannin and lactic acid have helped to raise the calcium level of wines. The iron content decreased due to the pre-fermentative treatments. The concentration of copper (Cu) was below the detection limit of 0.01 mg/l (SLD < 0.01 mg/l).

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References

Barón, R., Mayén, M., Merida, J. and Medina, M. 2000: Comparative study of browning and flavan-3-ols during the storage of white sherry wines treated with different fining agents. J. Sci. Food Agric. 80: 226-230
Bornet, A. and Teissedre, P.L. 2008: Chitosan, chitin-glucan and chitin effects on minerals (iron, lead, cadmium) and organic (ochratoxin A) contaminants in wines. Europ. Food Res. Technol. 226: 681-689
Cotea, D.V., Zănoagă, C. and Cotea, V.V. (2009): Tratat de oenochimie, volumul 1. – Bucureşti: Editura Academiei Române, 2009
Domingues, R.C.C., Braz, F., Cardoso, R. and Reis, M. 2011: Clarification of passion fruit juice with chitosan: Effects of coagulation process variables and comparison with centrifugation and enzymatic treatments. Process Biochem. 47: 467-471
Gallifuoco, A., d'Ercole, L., Alfani, F., Cantarella, M., Spagna, G. and Pifferi, P.G. 1998: On the use of chitosan-immobilized ß-glucosidase in wine-making: kinetics and enzyme inhibition. Process Biochem. 33: 163-168
Harbertson, J.F., Parpinello, G.P., Heymann, H. and Downey, M.O. 2011:Impact of exogenous tannin additions on wine chemistry and wine sensory character. Food Chem.

131: 999-1008

Jackson, R.S. (2008): Wine Science. Principles and Applications, Chapter 6: Chemical constituents of grapes and wine. 3rd ed. – London: Acad. Press, 2008

López, S., Castro, R., García, E., Pazo Jose, A.S. and Barroso, C.G. 2001: The use of activated charcoal in combination with other fining agents and its influence on the organoleptic properties of sherry wine. Eur. Food Res. Technol. 212: 671-675

Losada, M., Andrés, J. and Cacho, J. 2011: Influence of some prefermentative treatments on aroma composition and sensory evaluation of white Godello wines. Food Chem. 125: 884-891

OIV (2013a): Compendium of international methods of wine and must analysis. Vol. 1 and 2. – Paris: Organisation International de la Vigne et du Vin, 2013

OIV (2013b): International Code of Oenological Practices. 2012 ed. – Paris: Organisation International de la Vigne et du Vin, 2013

OIV (2013c): International oenological codex. – Paris: Organisation International de la Vigne et du Vin, 2013

Paneque, P., Álvarez-Sotomayor, T., Clavijo, A. and Isidoro, A.G. 2010: Metal content in southern Spain wines and their classification according to origin and ageing. Microchem. J. 94: 175-179

Parker, M., Smith, P.A., Birse, M., Francis, I.L., Kwiatkowski, M.J., Lattey, K.A., Liebich, B. and Herderich, M.J. 2007: The effect of pre- and post-ferment additions of grape derived tannin on Shiraz wine sensory properties and phenolic composition.Austral. J. Grape Wine Res. 13(1): 30-37

Pérez Trujillo, J.P., Conde, J.E., Pérez, P.M.L., Camara, J. and Marques, J.C. 2011: Content in metallic ions of wines from the Madeira and Azores archipelagos.Food Chem. 124: 533-537

Pomohaci, N., Stoian, V., Gheorghita, M., Sirghi, C., Cotea, V.V. and Namolosanu, I. (2000): Oenologie, Vol. 1: Prelucrarea strugurilor şi producerea vinurilor. – Bucureşti: Ed. Ceres, 2000

Puig-Deu, M., Lopez-Tamames, E. and Buxaderas, S. 1996: Influence of must racking and fining procedures on the composition of white wine. Vitis 35(3): 141-145

Rao, L., Hayat, K., Yi, Lv, Karangwa, E., Xia, S., Jia, C., Zhong, F. and Zhang, X. 2011: Effect of ultrafiltration and fining adsorbents on the clarification of green tea. J. Food Eng. 102: 321-326

Ribéreau-Gayon, P., Dubourdieu, D., Donèche, B. and Lonvaud, A. (2006a): Handbook of enology. Vol. 1: The microbiology of wine and vinifications. 2nd ed. – Chichester: Wiley, 2006

Ribéreau-Gayon, P., Glories, Y., Maujean, A. and Dubourdieu, D. (2006b): Handbook of enology. Vol. 2: The chemistry of wine: Stabilization and treatments. 2nd ed. – Chichester: Wiley, 2006

Sen, K., Cabaroglu, T. and Yilmaz, H. 2012: The influence of fining agents on the removal of some pesticides from white wine of *Vitis vinifera* L. cv. Emir. Food Chem. Toxicol. 50: 3990-3995

Singleton, V.L. and Rossi, J.A. 1965: Colorimetry of total phenolics with phosphomolybdic phosphotungsticacid reagents. Am. J. Enol. Vitic. 16: 1644-1658

Spagna, G., Barbagallo, R.N. and Piffer, P.G. 2000: Fining treatments of white wines by means of polymeric adjuvants for their stabilization against browning. J. Agric. Food Chem. 48: 4619-4627

Tschiersch, C., Pour Nikfardjam, M.S. and Schmidt, O. 2008: Comparison of seventeen different fining agents used with wine. Mitt. Klosterneuburg 58: 123-131

Waterhouse, A.L. 2001: Determination of total phenolics. Curr. Protoc. Food Anal. Chem. I1.1.1 - I1.1.8

Yokotsuka, K., Okuda, T., Hisamoto, M., Tajima, H. and Takayanagi, T. 2008: Effect of clarification and stabilization treatments on trans-resveratrol content of Delaware rose wine produced from UV-C irradiated grapes. J. ASEV. Jpn. 19(1): 25-32

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