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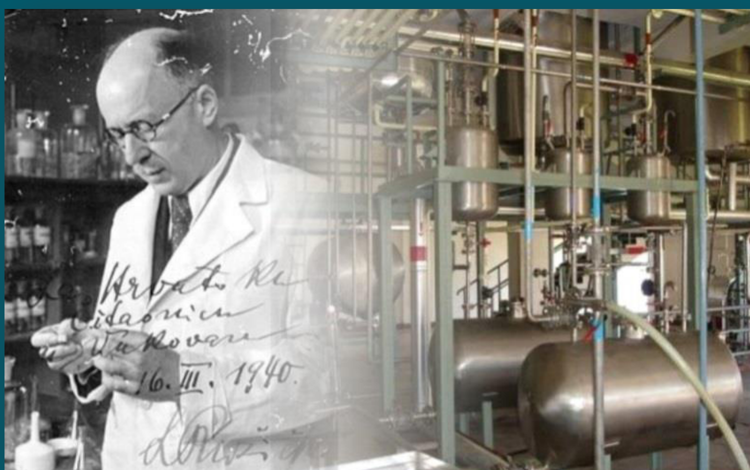

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Chemical and sensory properties of red wines from Baranja vineyards

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Summary

The aim of this paper was to compare the chemical and sensory properties of the Cabernet sauvignon, Frankovka, Merlot and Pinot noir wines over a period of one year. The following chemical parameters were examined in wines: alcohol, total acid, volatile acid, total dry extract, specific weight and free and total sulfur dioxide (SO_2). The sensory evaluation was performed by a 100-point method. The results showed that certain chemical parameters such as SO_2 decreased over time, and volatile acids as well as total acids, grow. Measurements showed that alcohol as a quality parameter in a slight decline as well as specific weight, considering that red wines are subject to deposition over time, which has an impact on the content of total dry extract. Also, since red wines evolve over time, all wines have got a bit higher rating than at the beginning. Expressed in points, the wines were rated as quality wines.

Keywords: chemical properties, sensory properties, red wines

Introduction

The quality of wine can be evaluated on the basis of physico-chemical parameters of wine like the amount of alcohol, total acids, volatile acids, total dry extract, specific weight and free and total SO_2 or according to sensory properties of wine (odor, taste, appearance or color). Interconnection between those parameters is also important (Daničić, 1985).

Alcohol content is not always crucial (higher or lower percentage), but its relationship with total acidity, total dry extract and odor can be important. If this relationship is harmonious, wine is harmonious. Total acids play an important role in the formation of a refreshing taste of wine. For wines containing less than 4 g l^{-1} of total acids, there is a suspicion of adulteration. The amount of volatile acids is usually between 0.4 and

0.8 g l^{-1}. Red wines have slightly more volatile acids than white wine. The amount of volatile acids exceeding 0.8 g l^{-1} indicates that the wine might not be for consumption. Wines with a higher amount of total dry extract have rounded taste. The total dry extract and the specific weight are connected: larger amount of total dry extract means higher specific weight. Sulfur in wine can acts as an antiseptic and keeps the wine from degradation. Maximum quantities in the wine must not exceed 30 mg l^{-1} or 160 mg l^{-1} for total sulfur, according to the Guidelines for wine (2005).
Sensory properties including color, clarity, aroma and taste of wine can depend on the amount of alcohol, acids or total dry extract (Daničić, 1985).
The primary objective of packaging is to protect and retain, as much as possible, the initial quality of wine. One of the main parameters affecting wine is the transfer of gases through the packaging material (Fu et al., 2009). The quality and durability of packaged wines may be different, given the different properties of the packaging (inertia, permeation, bending resistance, etc.). The influence of the package on the quality of wine was shown in earlier studies of Ghidossi et al. (2012) and Revi et al. (2014). Glass package is the best package for preserving the quality of wine since oxygen does not permeate through glass.
The aim of this paper was to determine physico-chemical parameters (alcohol, total acid, volatile acid, total dry extract, specific weight and free and total SO_2) and sensory properties of four types of red wines (Cabernet sauvignon, Frankovka, Merlot and Pinot noir) and observe the possible changes in physico-chemical and sensory properties during one year of storage in glass containers.

Materials and methods

Samples

Grapes from *Vitis vinifera* L. (Cabernet sauvignon, Frankovka, Merlot and Pinot noir), were cultivated on the slopes of the Ban's hill, Baranja vineyard county, areas of the wine-growing zone C1 of Republic of Croatia. After producing the wine in a winery, wines were bottled in glass and stored at a temperature of 15 to 18 °C. The wines were analysed after bottling and after a year of storing.
Physico-chemical analysis was performed in the wine laboratory of Vupik d.d., whereby the following parameters were determined: alcohol, total acidity, volatile acidity, total dry extract, specific weight and free and total SO_2. The instruments for measuring alcohol, volatile acidity, total dry extract and specific weight are in conformity with *O.I.V.* methods (Organisation Internationale de la Vigne et du Vin - International Organization of Vine and Wine) as prescribed by Commission Regulation (European Commission) No 606/2009.

Alcohol in wine

Alcohol in wine was determined by the distillation method based on the specific weight of the distillate at 20 °C compared to the water of the same temperature. A 100 ml of wine was transferred into a 1000 ml distillation flask. The second flask of 100 ml collected the distillate. The distillation was carried out in the water vapor stream. After the distillation was completed, the flask with distillate was filled up to the mark and tempered. After that, the distillate content was slumped into a cylinder set on the Gibertini apparatus and the specific weight of the distillate was read. Based on these data alcohol amount was read.

Total acidity

Total acidity (as tartaric acid) in wine was determined by the neutralization method with 0.1 M NaOH. Shortly, in a 10 ml wine sample, a few bromothymol blue droplets were added, followed by the titration with 0.1 M NaOH with the help of a digital burette. When the sample became blue-green, the titration was completed. The consumption of NaOH in ml was multiplied by 0.75 and the total acidity was expressed as g of tartaric acid per l of wine.

Volatile acidity

Volatile acidity (as acetic acid) in wine, expressed in g l^{-1} of acetic acid, was determined by the neutralization of the sample previously distilled into the water vapor stream, with 0.1 M NaOH and the phenolphthalein (indicator). A 20 ml of the sample was pipetted in a 1000 ml flask in which distillation was carried out in the water vapor stream on Gibertini apparatus. When 250 ml of distillate was collected, a few drops of phenolphthalein were added and titrated with 0.1 M NaOH solution until the solution became pink. The amount of NaOH used was denoted by n. Thereafter, one drop of H_2SO_4 solution (1:4) and 2 ml of 1 % starch solution were added after which a free sulfur dioxide was titrated with a 0.01 M solution of iodine. Used volume is indicated by n'. After that, a saturated sodium borate solution was then added to reappear the pink color. Total sulfur dioxide was titrated with 0.01 M iodine solution until purple color appeared. Now, used volume was indicated by n''. The concentration of volatile acid (A) was calculated according to the equation 1:

$$A = 0.300 \text{ x } (n - 0.1 \text{ x } n' - 0.05 \text{ x } n'') \qquad \text{(Eq. 1)}$$

Total dry extract

The total dry extract was determined densimetric from the remainder of the distillation. The equation 2 for the calculation is shown below:

$$d_r = d_w - d_a + 1 \qquad \text{(Eq. 2)}$$

where, d_r is relative density at 20 °C / 20 °C, d_w is density of wine, d_a is density of the wine distillate.
After d_r was calculated, the result was read based on that data and was shown in g l^{-1}.

Specific weight

Specific weight (or relative density) was determined based on the specific gravity of the wine sample at 20 °C compared to the water at the same temperature. The specific weight of the wine was determined immediately after tempering, and the specific weight of the distillate after distillation and tempering. Specific weight of both wine and distillate were measured when the samples were at 20 °C. At that temperature, the specific weight of the distillate is always lower than the specific weight of the wine.

Free and total SO_2

Free and total sulfur dioxide in wine was determined by iodometric method by Ripper. The free sulfur dioxide determination was based on the addition of 50 ml of wine, 10 ml of H_2SO_4 solution (1:4) and 3 ml of a 1 % starch solution to the Erlenmeyer flask. The mixture was titrated with a 0.01 M solution of iodine to the blue color appearance, stable half a minute. The consumption of iodine solution was multiplied by factor 12.8 and the free SO_2 concentration was expressed in mg l^{-1}.
To determine total sulfur dioxide content, 50 ml of wine and 25 ml of 1 M NaOH were added to the Erlenmeyer flask. The mixture was left to stand for 15 minutes for all SO_2 to move into free form. Then 15 ml of H_2SO_4 solution (1:4) and 3 ml of 1 % starch solution were added. The mixture was titrated with a 0.01 M solution of iodine to the blue color, stable for 30 seconds. The consumption of iodine solution was multiplied by factor 12.8 and the concentration of total SO_2 was expressed in mg l^{-1}.

Sensory evaluation

Six qualified and experienced wine tasters performed sensory evaluation of wine at the time of bottling and after one year of storing. The sensory evaluation was carried out according to the method of 100 positive points. That method is based on the evaluation of individual characteristics of the wine and assigning a certain number of points. On the basis of the number of points, wine categories were formed: at least 65 points - for table wine with controlled geographical origin; at least 72 points - for quality wine with controlled geographic origin; at least 82 points - for top quality wine with controlled geographical origin (Guidelines for wine, 2014).

Results and discussion

Chemical properties

The results of physico-chemical analysis are shown in Table 1. Examined wines contained 13.05 to 13.94 % of alcohol, 4.90 to 5.95 g l^{-1} of total acids, 0.37 to 0.64 g l^{-1} volatile acids, 26 to 29.67 g l^{-1} of total dry extract, and the specific weight was from 0.99215 to 0.99407. The free sulfur content in wines was in the range from 15.36 to 32.44 mg l^{-1}, and total sulfur content from 34.2 to 102.14 mg l^{-1}. Values of physico-chemical parameters are in accordance with amounts prescribed in guidelines for wine (2005) (minimum 10.5 % alcohol, minimum 20 g l^{-1} of sugar-free extract, minimum 4 grams per liter of total acids, maximum 1.2 grams per liter of volatile acids for wines from grapes grown in C1 zone of wine producing area of Republic of Croatia). The results are also in accordance with values in earlier studies (Ergović-Ravančić et al., 2013; Artem et al., 2014; Mesić et al. 2015). All wines showed similar values of physico-chemical parameters. Physico-chemical parameters are mostly stable during one year storage (Table 1).
The content of alcohol is a reflection of the specifics of the vintage for studied wine varieties. Concentration of total acids shows that the grapes were ripe when hand-picked. Content for volatile acids highlights the well-executed vinification and good conditions for the ripening of wine, but also filling the samples up to the top of the bottle. Reduction in specific weight as well as dry extract can be described in the direction of deposition of various compounds from the wine, manifested by lower concentration in specific weight. The difference can be seen only in the decreased amount of free and total SO_2 in all studied wines. This decrease is indicative of oxydation reactions in wines during storage (Lopes et al., 2009).
According to Danilewicz et al. (2008), under wine conditions, sulphur dioxide (SO_2) mainly exists in a form of bisulphite ion which react principally with hydrogen peroxide formed when ethanol and phenolic compounds are oxidised in the presence of iron and copper. The bisulphite may also react with quinones and reduce them to the original

state, thus preventing the oxidation of wine (Oliveira et al., 2011). Further, bisulfite binds with acetaldehyde to reduce some of the oxidized odor, and small quantities of sulfur dioxide added to old, oxidized wines, often makes the wine smell and taste fresher (Wildenradt, Singleton, 1974).
Although the amount of SO_2 decreased, there was still enough free SO_2 that protects the ingredients from oxidative changes in examined wines.

Table 1. Quality parameters of the examined wines measured by *O.I.V.**

Parameter of quality	Cabernet sauvignon		Frankovka		Merlot		Pinot noir	
	1	2	1	2	1	2	1	2
Alcohol (vol.%)	13.94	13.87	13.34	13.26	13.05	13.17	13.57	13.51
Total acid ($g\ l^{-1}$)$^{+}$	5.10	5.20	5.40	5.65	5.80	5.95	5.00	4.90
Volatile acid ($g\ l^{-1}$)$^{-}$	0.50	0.64	0.40	0.46	0.50	0.59	0.37	0.51
Total extract ($g\ l^{-1}$)	26.54	26.43	29.67	28.00	26.97	26.91	26.98	26.00
Relative density (20/20 °C)	0.99215	0.99222	0.99407	0.99355	0.99336	0.99319	0.99280	0.99257
Free SO_2 ($mg\ l^{-1}$)	31.80	16.64	28.10	16.24	29.06	15.36	32.44	16.92
Total SO_2 ($mg\ l^{-1}$)	72.08	53.76	64.20	46.16	88.42	47.36	102.14	34.20

**OIV* is an acronym for the International Organization of Vine and Wine
$^{-}$ expressed as acetic acid, $^{+}$expressed as tartaric acid. [1]means measuring at the beginning of the experiment, [2]means measuring after 12 months of storage

Table 2. The results of sensory evaluation of wines

Parameter of quality	Cabernet sauvignon		Frankovka		Merlot		Pinot noir	
	1	2	1	2	1	2	1	2
A	13.33	13.83	13.83	13.50	13.33	13.50	12.83	13.83
O	23.84	24.00	23.67	23.84	24.00	24.50	24.00	23.34
F	33.50	34.00	33.67	34.33	34.00	33.33	33.00	33.33
H	9.33	9.67	9.33	9.50	9.17	9.50	9.00	9.00
OR	80.00	81.50	80.50	81.17	80.50	80.83	78.83	79.50

A=Appearance, O=Odor, F=Flavor, H=Harmony, OR=Overall rate
Results represent mean values of the total sum of points of all 6 tasters
[1]means measuring at the beginning of the experiment, [2]means measuring after 12 months of storage

Sensory properties

Table 2 presents the results of sensory evaluation. All wines are graded similarly for appearance, odor, flavor and harmony. According to these results, all wines can be classified in the category of quality wines (up to 82 points) (Guidelines for wine, 2014). After one year of storage, a slight increase in the overall rate can be seen for all wines. This could suggest the development of reactions which contribute the better sensory evaluation (Ugliano, 2013; Coetzee, du Toit, 2016).
The evolution of wine post-bottling constitutes a slow and complex process where the wine closures play a fundamental role either as a result of their oxygen permeability or as a consequence of physico-chemical interactions with constituents of wine (Somers, Pocock, 1990; Monagas et al., 2005; Suárez et al., 2007; Caillé et al., 2010).

Conclusions

In this paper were examined chemical and sensory properties of the Cabernet sauvignon, Frankovka, Merlot and Pinot noir wines over a period of one year. All wines showed similar values of physico-chemical parameters. Sulfur content in all wines over a period of one year decreases. The content of total acid in most of the examined wines is slightly increasing, while the volume of volatile acid is slightly increasing for all wines. For most of the examined wines, alcohol concentrations, specific gravity and total dry extract, slightly decreased. All wines, based on the contents of most physico-chemical parameters, according to the current guidelines, can be classified into quality wines. Sensory evaluation showed that all wines are similarly rated in the category of quality wines.

References

Artem, V., Geana, E.-I., Antoce, A.O. (2014): Study of phenolic compounds in red grapes and wines from Murfatlar wine center, *Analele Stiint Univ.* 25 (1), 47-52.

Caillé, S., Samson, A., Wirth, J., Diéval, J.-B., Vidal, S., Cheynier, V. (2010): Sensory characteristics changes of red Grenache wines submitted to different oxygen exposures pre and post bottling, *Anal. Chim. Acta*. 660, 35–42.

Coetzee, C., du Toit W. J. (2016): Sauvignon blanc wine: Contribution of ageing and oxygen on aromatic and non-aromatic compounds and sensory composition: A Review, *S. Afr. J. Enol. Vitic*. 36 (3), 347-365.

Commission Regulation (European Commission) No 606/2009 of July 10, 2009 laying down certain detailed rules for implementing Council Regulation (EC) No 479/2008 as regards the categories of grapevine products, oenological practices and the applicable restrictions; Official Journal of the European Union: 24 July, 2009; L193/1.

Daničić, M. (1985): Tehnologija vina – praktikum. Poljoprivredni fakultet, Beograd-Zemun.

Danilewicz, J. C., Seccombe, J. T., Whelan, J. (2008): Mechanism of interaction of polyphenols, oxygen, and sulfur dioxide in model wine and wine, *Am. J. Enol. Vitic.* 59, 128-136.

Ergović-Ravančić, M., Obradović, V., Mesić, J., Škrabal, S., Babić, J., Jakobović, S. (2013): Utjecaj ambalaže i vremena skladištenja na boju bijelog vina. In: 48th Croatian & 8th International Symposium on Agriculture Proceedings, Marić S., Lončarić Z. (ed.), Osijek, Poljoprivredni fakultet Osijek, HR, pp. 879-882.

Fu, Y., Lim, L.T., McNicholas, P.D. (2009): Changes on enological parameters of white wine packaged in bag-in-box during secondary shelf life, *J. Food Sci.* 74 (8), C608-C618.

Ghidossi, R., Poupot, C., Thibon, C., Pons, A., Darriet, P., Riquier, L., De Revel, G., Mietton-Peuchot, M. (2012): The influence of packaging in wine conservation, *Food Control*. 23 (2), 302-311.

Guidelines on amendments to the guidelines on organoleptic (sensory) assessment of wine and fruit wines (2014): Narodne novine, number 48, Zagreb, Republic of Croatia. Accessed on: 06.11.2018.

Guidelines on wine production (2005): Narodne novine, number 2, Zagreb, Republic of Croatia. Accessed on: 06.11.2018.

Lopes, P., Silva, M.A., Pons, A., Tominaga, T., Lavigne, V., Saucier, C., Darriet, P., Teissedre, P.-L., Dubourdieu, D. (2009): Impact of oxygen dissolved at bottling and transmitted through closures on the composition and sensory properties of a Sauvignon blanc wine during bottle storage, *J. Agric. Food Chem.* 57 (21), 10261-10270.

Mesić, J., Obradović, V., Ergović-Ravančić, M., Svitlica, B. (2015): Utjecaj trajanja maceracije na kemijski sastav i organoleptička svojstva vina Cabernet sauvignon. In: 50th Croatian and 10th International Symposium on Agriculture Proceedings, Pospišil, M. (ed.). Zagreb, HR, pp. 539-543.

Monagas, M., Bartolomé, B., Gómez-Cordovés, C. (2005): Evolution of polyphenols in red wines from *Vitis vinifera* L. during aging in the bottle, *Eur. Food Res. Technol.* 220 (3-4), 331-340.

O.I.V. (2007): Compendium of International Methods of Wine and Must Analysis. Vol. 1., Paris, France.

Oliveira, C.M., Ferreira A.C.S., De Freitas V., Silva A.M.S. (2011): Oxidation mechanisms occuring in wines, *Food Res. Int.* 44 (5), 1115-1126.

Revi, M., Badeka, A., Kontakos, S., Kontominas, M.G. (2014): Effect of packaging material on enological parameters and volatile compounds of dry white wine, *Food Chem.* 152, 331-339.

Somers, T.C., Pocock. K.F. (1990): Evolution of red wines III. Promotion of the maturation phase, *Vitis.* 29, 109-121.

Suárez, R., Monagas, M., Bartolomé, B., Gómez-Cordovés, C. (2007): Phenolic composition and colour of *Vitis vinifera* L. cv Merlot wines from different vintages and aging time in bottle, *Ciência Téc. Vitiv*. 22 (2), 35-44.

Ugliano, M. (2013): Oxygen contribution to wine aroma evolution during bottle aging, *J. Agric. Food Chem.* 61 (26), 6125–6136.

Wildenradt, H.L., Singleton, V.L. (1974): The production of aldehydes as a result of oxidation of polyphenolic compounds and its relation to wine aging, *Am. J. Enol. Vitic*. 25, 119-126.