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The quality of white wines fermented in Croatian oak barrels

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Abstract

Croatian barrels are traditionally made of the oak wood from the region of Slavonia, but its influence on wine quality has not been explored scientifically. This paper is a first investigation of Croatian barrique barrels and their influence on wine quality. Chardonnay and Sauvignon musts were fermented in new light and medium-toasted Croatian barrique barrels (225 l) and in steel tanks of the same volume. Chemical analysis of phenolic acids and phenolic aldehydes were made by HPLC just after fermentation. The wines were sensory tested by the descriptive method and the O.I.V./U.I.O.E. method by 100 positive points. The concentrations of phenolic compounds varied in the wines compared. Sauvignon wines generally had some higher total quantities of phenolic acids when compared with Chardonnay wines. Our results indicated that sensorial characteristics of produced wines were modified, probably due to the wood-derived compounds.

Keywords: Barrique; White wines; Oak phenols; Sensory properties

1. Introduction

One of the practices used to intensify the aroma and flavour characteristics of white wines is to ferment the must in oak barrels, and Chardonnay is one of the most suitable varieties for this. Wines produced by fermentation and maturation in oak barrels have different flavour characteristics to those, which have undergone barrel maturation only after fermentation in stainless steel. One reason for this phenomenon is that actively growing yeasts are capable of transforming volatile flavour components, extracted from oak wood, into other volatile metabolites (Humphries, Jane, & Sefton, 1992). It is of considerable interest to winemakers and coopers to know that oakwood obtained from different species or of the same species from different sites contains varying amounts of important aromatic aldehydes (Miller, Howell, Michaelis, & Dickmann, 1992). The accumulation of oak volatile compounds in wine during storage in oak barrels can depend on many factors (Spillman, Iland, & Sefton, 1998). Although hundreds of volatile compounds have been identified in untoasted oakwood, relatively few volatiles, including vanillin, are present in significant amounts (Spillman, Pollnitz, Liacopoulos, Skouromounis, & Sefton, 1997). The degradation of oakwood lignin generates a variety of volatile phenols, which can be extracted from the wood into the wine. The most abundant of these compounds are vanillin and syringaldehyde. Vanillin, present in all kinds of wood, is the most important because of its characteristic scent of vanilla. It can be used as an indicator of fermentation and aging in oak barrels (Sefton, Francis, & Williams, 1989). In the white wines this apparently occurred only during barrel fermentation and maturation on lees (Puech, 1987). The oak species most commonly used in barrel making are *Quercus alba*, also known as American oak, *Quercus petrea* and *Quercus robur* which grow in Europe, the most popular being French oak (Humphries et al., 1992). Croatian oak is famous worldwide and is traditionally exported, but its influence on wine has never been scientifically explored.

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Because of that in the period from 2000 to 2002 the influence of fermentation on the quality of wine from French and Croatian oak barrels was investigated and the results suggested no significant differences between the tested oak barrels. On the contrary, wines from Croatian oak barrels were in some cases even better than wines from French oak barrels (Herjavec, 2002).

The objective of this study was to describe the differences in chemical composition and sensory properties of the Chardonnay and Sauvignon wines produced in new light and medium-toasted Croatian barrique barrels and their comparison with the wines of the same varieties fermented in steel tanks.

2. Material and methods

2.1. General

Chardonnay and Sauvignon wine grapes obtained from the continental wine region of Croatia were harvested during the 2001 season. The free-run juice was treated with 50 mg/l SO_2 and allowed to settle overnight. The juice was racked and the must distributed into new barrique barrels (*Q. petrea*, light and medium-toasted). Must alcoholic fermentation was carried out with selected *Saccharomyces paradoxus* RO 54 strain obtained from the Department of Microbiology, Faculty of Agriculture, University of Zagreb. Yeast strain culture was preincubated in sterilized grape must for 48 h at 25 °C and finally inoculated at 8×10^6 CFU/ml. Sugar degradation in all wines was completed in 30 days. The samples of all barrels and steel fermented wines were chemically and sensory analyzed.

2.2. Chemical analyses

Routine analyses of basic components in the must and wines were made using standard methods (Majdak, Herjavec, Orlic, Redzepovic, & Mirosevic, 2002). The phenolic acids and phenolic aldehydes were analyzed by the HPLC method (Silva, Mazzoleni, & Parodi, 1999).

2.3. Sensory analysis

The wines were subjected to sensory evaluation by the 100-point O.I.V./U.I.O.E method (Crettenand, 1999) and by descriptive analyses (Lindblom, 1999), with a panel of 13 judges. Analyses of variance were run on each descriptor and significant differences among the samples observed as shown in Table 1.

Table 1
Chemical composition of Chardonnay and Sauvignon musts

Compound	Year	
	Chardonnay Plesivica vineyard 2001	Sauvignon Kutjevo vineyard 2001
^{0}Oe	97	91
Total acidity[a] (g/l)	7.8	8.2
NTU[b]	282	190
PH	3.10	3.21

[a] As tartaric acid.
[b] Nephelometric turbidity units.

3. Results and discussion

3.1. Chemical composition

The results presented in Table 2 show that *S. paradoxus* strain 54 metabolised the total must sugar content, confirming its good fermentation abilities, as reported in earlier experiments (Majdak et al., 2002). There were no differences in simple chemical composition between the barrel and inox-fermented wines. In Table 3 initial results are reported about phenolic compounds in the wines fermented in Croatian barrique barrels. The barrels used in this experiment were from the same cooper, so that the sources of this variation could lie in the inherent variability of all biological systems, including oak trees, and in the low reproducibility of traditional cooperage practices such as open-air seasoning and oak-fire toasting. Furthermore, since the cooper determines the toast level visually and since no uniform objective definition of the various toast

Table 2
Chemical composition of Chardonnay and Sauvignon wines

Compound	Chardonnay			Sauvignon		
	Inox	Light	Medium	Inox	Light	Medium
Alcohol (vol%)	12.7	13.0	12.9	12.4	12.7	12.6
Reduc. sugar (g/l)	3.0	1.75	3.25	1.6	1.0	1.0
Total acidity[a] (g/l)	5.4	5.8	5.9	5.2	5.5	6.3
Volatile acidity[b] (g/l)	0.40	0.46	0.46	0.34	0.45	0.42
pH	3.48	3.37	3.38	3.51	3.41	3.35
Ash (g/l)	2.37	2.30	2.39	2.10	2.12	2.23

[a] As tartaric acid.
[b] As acetic acid.

Table 3
Phenolic compounds in Chardonnay and Sauvignon wines in mg/l

Compound	Chardonnay			Sauvignon		
	Inox	Light	Medium	Inox	Light	Medium
3-Hydroxybenzoic acid	0.41	0.24	0.52	0.35	0.33	1.32
4-Hydroxybenzoic acid	1.29	0.8	1.74	0.48	1.33	3.06
Caffeic acid	0.40	0.29	0.20	1.87	0.81	0.30
Chlorogenic acid	0.60	2.90	2.35	1.96	1.52	1.87
Coumaric acid	0.70	0.66	nd	0.57	0.42	0.25
Ferulic acid	nd	nd	nd	0.40	0.21	0.30
Gallic acid	1.48	1.26	1.85	3.73	3.12	1.70
Syringic acid	0.51	2.10	1.20	0.16	1.16	nd
Vanillic acid	0.62	1.02	1.38	nd	1.73	0.63
∑acids	6.01	9.27	9.24	9.52	10.63	9.43
Syringaldehyde	1.97	2.96	2.1	0.89	2.90	1.23
Vanillin	nd	0.36	0.32	nd	0.73	0.60
∑aldehydes	1.97	3.32	2.42	0.89	3.63	1.83