Primary Study of Viticultural and Oenological Characteristics of 'Plavac Mali Sivi' and its Comparison with 'Pošip' and 'Grk' in the Central Dalmatia

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Summary

Characterization of 'Plavac Mali Sivi', a mutant of 'Plavac Mali' noir, having grey berry skin colour, and its comparison with well-known white cultivars in the region of Dalmatia 'Pošip' and 'Grk' were performed in this study. Basic viticultural and oenological characteristics were evaluated in three growing seasons in the grape germplasm repository. 'Plavac Mali Sivi' showed lower yield per vine, and cluster weight than other two cultivars. Number of berries per cluster differed significantly among cultivars. 'Plavac Mali Sivi' had significantly lower total acidity than 'Pošip' and 'Grk'. High oenological variability among these three cultivars was found. 'Plavac Mali Sivi' had a relatively high content of alcohol (13.9 vol.%) and equal to 'Pošip' (13.9 vol.%), and significantly different from the 'Grk' (12.8 vol.%). The highest content of dry extract was determined at 'Pošip', while 'Plavac Mali Sivi' and 'Grk' were not significantly different. The results of this study indicate the possibility of providing a new white wine for the market from recently propagated mutant 'Plavac Mali Sivi' in the region of Dalmatia and justify further technological investigation.

Key words

Plavac Mali Sivi, mutant, enological variability, Dalmatia, white wine

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Introduction

'Plavac Mali Sivi' is a pink berried bud sport of major Croatian red cultivar 'Plavac Mali' (*Vitis vinifera* L.) (Jelaska, 1960; Mirošević, 1988). Mutations, especially those linked to berry colour, can significantly affect grape quality and change the type of wine produced. The red cultivar 'Plavac Mali' is best-suited for the costal and island region of Dalmatia, southern Croatia. The finest of these red wines are achieved on steep southern slopes next to the sea such as: Dingač and Postup (Pelješac Peninsula), Ivan Dolac and Sv. Nedjelja (Island of Hvar), and Bol and Murvica (Island of Brač). Given suitability of 'Plavac Mali n.' to the unique Dalmatian viticultural climate, as well as the localized mutation within the entire genome, we believe that 'Plavac Mali Sivi' (Plavac Mali the Grey) has retained positive varietal characteristics and could be quite good for white wine production. Additional value comes from the fact that autochthonous cultivars suitable for high quality white wine production in the hot Mediterranean climate of Dalmatia are very limited.

More than 80 autochthonous cultivars exist in Croatia (Pejić et al., 2000). Among them only a few cultivars are nowadays cultivated for commercial wine production. In recent years, research of autochthonous cultivars has been focused mainly on conservation, phenotyping and genotyping (Maletić et al., 1999; Zdunić et al., 2007) with only a few works directed to specific chemical compounds of Dalmatian white wines (Budić-Leto and Lovrić, 2002).

Despite the growing importance of wine production in Dalmatian economy, little published information is available on cultivar performance under Dalmatian growing conditions. Currently, 'Pošip' is the leading white cultivar in Dalmatia, with a reputation for relatively high, consistent yield, and excellent fruity-floral flavour of its wines. Information about field trials with this native cultivar are many years old (Bulić, 1949; Gazzari, 1952, 1953) or never formally published.

Characterization of viticultural and oenological value in clonal trials necessitates analysis of yield components and fruit composition (Castagnoli and Vasconcelos, 2006). High importance is placed on evaluation of wine quality and micro-scale vinification has been integrated into trials in many clonal selection programs (Zamuz et al., 2007).

Germplasm collection at the Institute for Adriatic Crops, in Split, includes more than 120 accessions of local (presumably native) cultivars and facilitates the first comprehensive evaluation and comparison. Traditionally, Dalmatian growers prefer planting of well adapted and good yielding native cultivars such as 'Plavac Mali'. It is well known also, that high quality white cultivars are in deficit in this region. The aim of this study was to evaluate the berry skin colour mutant of 'Plavac Mali' - 'Plavac Mali Sivi'(PMS) - in terms of its viticultural and oenological properties and to compare it with 'Pošip' and 'Grk' (as best local standards for quality) under similar production practices.

Material and methods

Grapes

Three cultivars, 'Pošip', 'Grk' and 'Plavac Mali Sivi' (*Vitis vinifera* L.) from the grape germplasm repository of the Institute for Adriatic Crops and Karst Reclamation in Split were evaluated for the first time regarding viticultural and oenological characteristics in the period 2008-2010. The cultivars were grown under equal cultivation and climatic conditions in a vineyard established in 2005. Grafted onto 1103-Paulsen rootstocks, and trained on the bilateral spur cordon system with spacing of 1.0 m among vines in row and 2.0 m between rows, eight buds were pruned on each vine.

Clusters of each cultivar were picked up at technological ripening stage. 'Plavac Mali Sivi' and 'Pošip' were harvested at the same date, but a 'Grk' a week later. Clusters per vine and the yield of each individual vine were measured. Cluster weight (g), length (cm) and width (cm) were quantified for ten randomly collected clusters per cultivar. The number of berries was counted for each representative cluster and berry weight determined. The ten-cluster samples were manually crushed and sugar content (°Brix) in their must measured using a temperature-compensating refractometer (Atago, model WM-7). Total titratable acidity (g/L) of the must was measured using 1 M NaOH with Bromothymol blue as indicator. Juice pH was measured with a pH meter (Methrom, model 719 S). Measurements of fruit composition (sugar, total titratable acidity, pH) were repeated on an additional ten-cluster sample for each cultivar.

Microvinification and analysis of wines

All grapes per cultivar (approximately 15 kg) were retained for winemaking each year in order to produce varietal wine.

Grapes were hand crushed, sulfited to 25 mg/L free sulphur dioxide (SO_2) and stored in a 10-liter glass container. Micro-scaled fermentation was carried out at 18°C using commercial strain EC1118 (*Saccharomyces bayanus*, Lallemand Inc, Canada). Then the wine was racked and sulfited to 50 mg/L (SO_2). The second racking was done in April and the wine was bottled after the correction of free SO_2 level to 20-30 mg/L. Malolactate fermentation was not performed. Two months after bottling wine samples were analyzed for basic quality parameters in duplicate following the standard methods recommended by O.I.V. (2005).

Statistical analysis

Two-factor analysis of variance (ANOVA) for cultivar x year using the statistical software Statistica 8.0 (StatSoft, Inc., USA) provided estimates of varietal and annual differences. Standard error was determined using Fisher LSD with a 0.05 level of significance.

Results and discussion

Yield and cluster characteristics of 'Plavac Mali Sivi', 'Grk' and 'Pošip' (Table 1) showed that differences in yield components were not consistent and varied by annual season. There were cultivar by year interaction effects for number of berries and berry weight.

The PMS produced the least amount of fruit per vine (2.17 kg/vine) while 'Pošip' and 'Grk' produced significantly more of which 'Grk' the most (3.82 kg/vine). Average yield over the three year period ranged from 2.46 kg/vine in 2008 to 4.10 kg/vine in 2010. The average cluster weight of PMS of 280.51 (g) was significantly lower than of 'Pošip' and 'Grk' (Figure 1). The number of berries varied significantly among all three cultivars with PMS having the least (156 berries per cluster), 'Pošip'

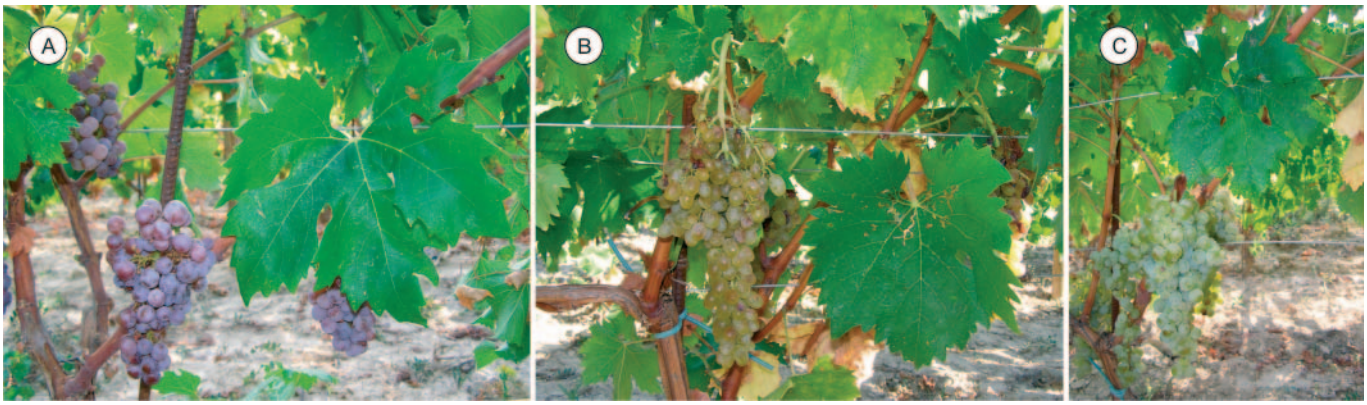

Figure 1. Apperance of (A) 'Plavac Mali Sivi' (PMS), (B) 'Pošip' and (C) 'Grk' grape clusters. Photos taken in 2009 at vineyard of grapevine germplasm repository of Institute for Adriatic Crops, Split, Croatia

Table 1. Means and standard errors of yield and cluster characteristics of 'Plavac Mali Sivi' (PMS), 'Pošip' and 'Grk', Split, Croatia, 2008-2010.

	Yield (kg/vine)	Cluster/vine	Cluster length (cm)	Cluster width (cm)	Cluster weight (g)	Berries/cluster	Berry weight (g)
Cultivar							
PMS	2.17±0.59 b	12±2.30 a	15.55±0.28 b	12.34±0.31 b	280.51±16.96 b	156±11.79 c	1.93±0.12 a
Pošip	3.30±0.27 a	12±0.78 a	22.38±0.52 a	13.54±0.42 a	365.26±14.78 a	196±10.33 b	1.90±0.06 a
Grk	3.82±0.27 a	14±0.91 a	22.60±0.51 a	13.61±0.40 ab	377.27±17.32 a	305±22.66 a	1.29±0.05 b
Year							
2008	2.46±0.26 b	10±0.63 b	22.12±0.74 a	14.08±0.42 a	348.18±16.60 ab	254±12.53 a	1.35±0.06 c
2009	—*	—*	19.70±0.71 b	12.34±0.46 b	387.30±20.63 a	259±24.46 a	1.67±0.10 b
2010	4.10±0.23 a	15±.0.86 a	19.69±0.61 b	13.10±0.33 ab	311.26±14.40 b	143±8.22 b	2.19±0.07 a
Interaction							
Cultivar x Year			ns	ns	ns	<0.0001	<0.0001

Means followed by the same letter within columns and factors are not significantly different by Fisher LSD test, $p < 0.05$; ns = not significant; * - missing data

Table 2. Means and standard errors of sugar (Brix), total titratable acidity (g/L) and pH of grape juice from 'Plavac Mali Sivi' (PMS), 'Pošip' and 'Grk', Split, Croatia, 2008-2010.

	Sugars (Brix)	Total titratable acidity (g/L)	pH
Cultivar			
PMS	20.6±0.44 b[1]	5.1±0.16 c	3.51±0.03 a
Pošip	22.7±0.34 a	6.1±0.34 b	3.53±0.02 a
Grk	21.0±0.17 b	7.7±0.12 a	3.37±0.03 b
Year			
2008	21.5±0.52 a	6.52±0.41 a	3.49±0.03 a
2009	21.5±0.16 a	6.86±0.46 a	3.50±0.03 a
2010	21.2±0.73 a	6.44±0.61 b	3.42±0.04 a
Interaction			
Cultivar x Year	0.001	ns	ns

Means followed by the same letter within columns and factors are not significantly different by Fisher LSD test, $p < 0.05$; ns = not significant

significantly more (196) than PMS and 'Grk' significantly more than the two others (305 berries per cluster).

No significant difference in average weight of berries was found between PMS (1.93 g) and 'Pošip' (1.90) while 'Grk' had the smallest berries (1.29 g). Berry weight was strongly affected by annual season. The 3-year average berry weight ranged from 1.35 (g) in 2008 to 2.19 (g) in 2010. Berry weight is considered a quality indicator and wines produced from smaller berries thought to be more intense in pleasant flavour (Bettiga et al., 2003). Too, large berries often contribute to the development of cluster density that creates conditions conducive to sour rot.

Sugar, total acidity, and pH are common indicators of fruit maturity and are known to vary by genotype and agro-ecological condition (Jackson and Lombard, 1993). The content of sugar of all the observed cultivars can be considered satisfactory for a white table wine according to EU standards (1999) (Table 2). The cultivar 'Pošip' had significantly higher sugar content at harvest than PMS and 'Grk'. Regarding total titratable acidity, PMS was found to have significantly lower total acidity than 'Pošip' that in turn was significantly lower than the 'Grk' cultivar. This suggests that technological maturity of PMS could be much earlier than the other two tested cultivars. The pH was found to be the lowest in 'Grk' (3.37) reflected its later grape maturation than the others. Lower pH values increase the antiseptic action of free sulphur dioxide and prevents the growth of acetic bacteria (Ribéreau-Gayon, et al., 2006). There was no Cultivar x Year interaction for sugar, total acidity, and pH.

Table 3. Wine composition of 'Plavac Mali Sivi' (PMS), 'Pošip' and 'Grk' evaluated in Split, Croatia, 2008-2010. Means and standard errors represent two technical repetitions.

	Ethanol (% v/v)	Dry Extract (g/L)	Reducing sugars (g/L)	Ash (g/L)	pH	Total acidity (g/L)	Volatile acidity (g/L)
Cultivar							
PMS	13.90±0.44 a	20.43±0.96 b	2.4±0.25 a	2.54±0.06 b	3.54±0.03 b	5.23±0.10 c	0.40±0.04 a
Pošip	13.89±0.11 a	22.05±0.31 a	1.7±0.09 c	2.94±0.07 a	3.62±0.01 a	5.53±0.14 b	0.37±0.05 a
Grk	12.85±0.42 b	20.92±0.52 b	1.8±0.11 b	2.14±0.07 c	3.25±0.01 c	6.75±0.08 a	0.35±0.01 a
Year							
2008	14.21±0.51 a	22.08±0.32 a	2.2±0.31 a	2.71±0.13 a	3.43±0.07 b	6.16±0.36 a	0.36±0.02 a
2009	12.74±0.06 c	20.87±0.24 b	1.8±0.08 b	2.37±0.13 c	3.48±0.07 a	5.72±0.28 c	0.35±0.05 a
2010	13.70±0.19 b	19.75±0.68 c	1.8±0.08 b	2.51±0.16 b	3.46±0.06 a	5.80±0.25 b	0.40±0.04 a
Interaction							
Cultivar x Year	<0.0001	<0.0001	<0.0001	0.005	<0.0001	<0.0001	<0.0001

Means followed by the same letter within columns and factors are not significantly different by Fisher LSD test, $p < 0.05$; ns = not significant

Table 3 shows monovarietal wine composition of the investigated cultivars. PMS and 'Pošip' had relatively high ethanol content (13.90 and 13.89 vol.%) and did not differ significantly from each other while the 'Grk' cultivar had significantly lower ethanol content.

Though each varietial differed in its quantity of reducing sugars, all wines produced belong to the dry category because reducing sugars after alcoholic fermentation were less than 5 g/L (EC, 1999).

The dry extract was the highest in monovarietal wine of 'Pošip' and differed significantly from PMS and 'Grk' that had similar amounts and did not differ from each other.

The total acidity was the lowest in PMS (5.2 g/L), significantly higher content was found in 'Pošip' (5.5 g/L), while 'Grk' had the significantly highest content (6.7 g/L).

In summary, PMS had fewer larger berries per cluster though it had lower yield per vine than the other two cultivars. The varietal vine of PMS had the lowest total acidity.

Conclusions

Three cultivars 'Pošip', 'Grk' and 'Plavac Mali Sivi' (*Vitis vinifera* L.) were studied in a field trial and they significantly differed in grapes and wines quality. This is the first report and comparison with white cultivars of 'Plavac Mali Sivi' regarding its quality parameters of grape and wine. The results due to high quality according to Croatian classification of wines for market indicated the possibility of producing of a new varietal white wine from 'Plavac Mali Sivi'. All cultivars deserve to be cultivated for wine production in the region.

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