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IDENTIFICATION OF PHENOLIC COMPOUNDS AND CHANGES IN THEIR CONTENT DURING PROCESSES OF WHITE WINES

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ABSTRACT

Gaziantep (in Turkey) is one of the oldest cities in the World, in which the history of winemaking and viticulture began in ancient ages. It is home to wild white grapes *Vitis vinifera* Dökülgen and Paf. Three young white wines were produced from these two grapes. Ten phenolics and some chemical characteristics were quantitatively detected in the white wines and musts depending on white wine processes. Phenolic compounds significantly ($p<0.05$) increased during the fermentation process. After aging, (+)-catechin and procyanidin B2 contents of white wines were ranged from 1.12 to 1.35 and from 60.69 to 69.02 mg/L respectively. After aging, the quercetin, rutin and myricetin contents of white wines-1, 2 and 3 were ranged from 0.47 to 0.59, from 0.28 to 0.32 and from 0.11 to 13 mg/L respectively. White wines represented with abundant flavanols, tyrosol and chlorogenic acid produced from Dökülgen and Paf mixture with 7:3 ration. It was found that there is a significant difference between hydroxycinnamic acid and hydroxybenzoic acid content of white wines. Dökülgen and Paf white grapes contribute higher amount of phenolic characteristics, better acidity and sugar to white wine while Dökülgen grape contributed more sugar.

1. Introduction

The phenolic compounds in wines change according to the grape type, ripeness of the grapes, the irrigation and fertilization of the soil, viticulture and the climatic conditions of the region, fermentation (yeast flora, pH and temperature), and wine production techniques (Erkmen and Bozoglu, 2016). The Southeast region of Anatolia is one of the most successful wine regions with its excellent climate, soil and geographical features suitable for viticulture. In this region, 65 kinds of grapes were grown. Dökülgen, Paf, Kabarcık, Rumi, Dımışkı, and Muhammediye are major white grapes (Celik et al., 2005; Erkmen, 2005). Regional differences affect the development of the vine, ripening of grapes, the composition and sensory properties of grapes and wine. The region conditions are important factors that determine the quality and style of wine (Bekar and Bayram, 2016). Phenolic compounds play important roles in the quality of the wine. There has been no report on the phenolic characterization of white wines produced from Southeast region grapes as well as the southeast region of Turkey. This research has been carried out to indicate young white wine production from Gaziantep grapes, to reveal the importance of grapes in the white wine production, to indicate suitability of white grapes for wine production, to indicate regional process condition on white wine production and to indicate the availability of grapes for white wine production with specified

phenolic characteristics. The evolution of ten phenolic compounds were conducted during production steps of young white wines produced from Dökülgen and Paf white grapes. Brix, pH, alcohol and free SO_2 changes during white wine processes were also studied.

2. Materials and Methods

Two white grapes (vernacular "Dökülgen and Paf") from *Vitis vinifera* subsp. *sylvvestris* L. cultivated in Southeast region of Turkey were harvested from vineyards in September 2018 at the appropriate maturity in 20 kg plastic crates and transported to the winery in the Food Engineering Department (Gaziantep University, Gaziantep, Turkey). Dry yeast *Saccharomyces cerevisiae* (LALVIN ICI-D47), potassium metabisulfite (PMB, $K_2S_2O_5$), yeast nutrient (VitaStart) and disinfectant (Bioxeco-5) were obtained from Vinomarket (İzmir, Turkey). HPLC-grade chemicals and standard phenolic compounds were supplied from Sigma-Aldrich (Interlab, Adana, Turkey).

2.1. White wine production

Three white wines were produced from Dökülgen and Paf grapes. All wines were processed in the same way according to the process scheme given in Fig. 1. White wine production steps used in this manuscript were explained by Ceyhan (2019). Wines were filled into dark green colored bottles (75 ml) and the bottles were capped with cork using cork stopper closing machine (Atlantis Cam Ambalaj Ltd. Şti., İzmir, Turkey). The bottles were aged in the horizontal position for 3 months in the darkroom at 20°C.

2.2. Analysis

About 150 ml of the samples were removed in duplicate during fermentation (after 3, 5 and 12 days), after resting (7 days), after maturation (45 days) and after aging (3 months). Samples were also removed from musts. The Brix, alcohol, pH and phenolic compounds analysis were made from must and white wine samples. *S. cerevisiae* and yeast counts, and pH analysis were also carried out from white wine samples according to the standard methods (Erkmen, 2022). Water-soluble dry matter of samples was determined by the refractometer at 20°C. Electronic ebulliometer (Bulteh 2000, Stara Za gora, Bulgaria) was used for the alcohol analysis with the calcoholometric method (OIV, 2019). Free sulfur dioxide (SO_2) analyses were performed by the calorimetic method (Aktan and Kalkan, 2000).

Phenolic compounds analyze. The water used in the analysis was obtained from a Milli-Q water purification system (Millipore; Bedford, MA, USA). All solvents used were previously filtered through 0.45 μm membrane filter (Millipore) and degassed before use. Phenolic standard solutions. For all standards (gallic acid, (+)-catechin hydrate, routine hydrate, procyanidin B2, p-coumaric acid, chlorogenic acid, resveratrol, tyrosol, myricetin, and quercetin), stock solutions were prepared by dissolving the phenolic compounds at four different concentrations with the methanol-water solution (50:50 v/v). The phenolic standards were determined by HPLC (Gomez-Alonso et al., 2007; Burin et al., 2011) and the results were given in mg/L.

Chromatographic analysis was performed using a Shimadzu LC-20AB (Shimadzu Corporation, Kyoto, Japan) high-performance liquid chromatography (HPLC) equipped with a vacuum degasser (DGU-20A5), quaternary-pump LC-10AT, UV detector (SPD-20A), SIL- autosampler (20A HT) and VP column furnace (CTO-10AS). The LCsolution (v.1.25; 2002-2009 Shimadzu Corporation) was used to control the gradient settings, UV and data acquisition. The separation was performed using a C18 analytical column of 4.6 mm x 250 mm, 5 μm particle size (GL Sciences, Kyoto, Japan). A C18 guard column of 4.6 mm x 12.5 mm, 5 μm particle size (GL Sciences, Kyoto, Japan) was used to prevent contamination of the analytic column from any non-soluble residues coming from the samples. Peak areas were determined at 280 and 320 nm wavelengths for all phenolic compounds.

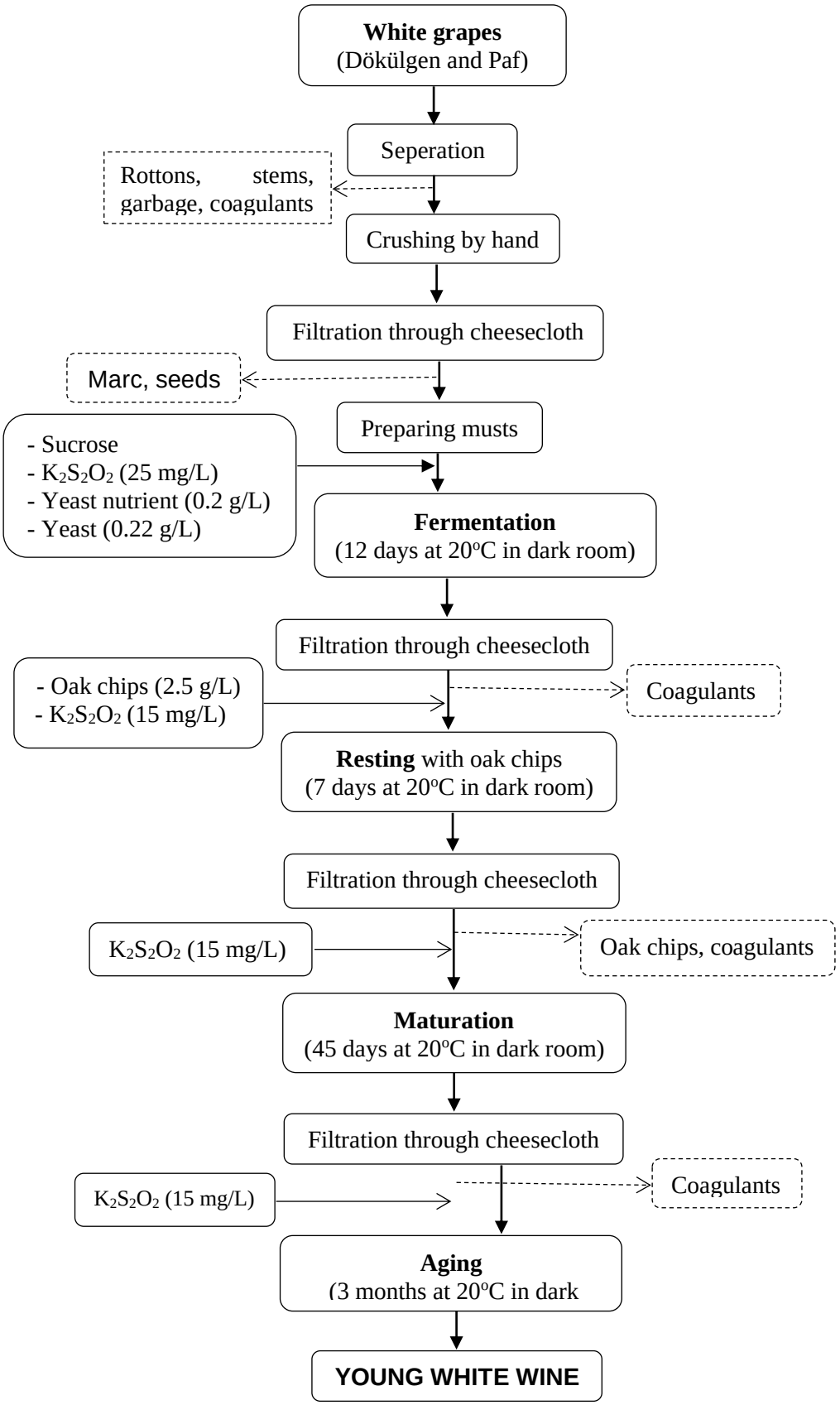

Figure 1. General White wine production flow chart

The samples were centrifuged for 5 min at 5000 rpm. Approximately 2 mL of the resulting solution was removed with a 0.45 μm PTFE syringe filter (Millipore) and added into 1.5 mL colored vial. Samples were analyzed as soon as possible using HPLC. In the quantitative analysis of phenolic compounds, the modified HPLC methods were used (Gomez-Alonso et al., 2007; Burin et al., 2011). Two solvent gradient elutions were used in the study. Solvent A is the acetic acid-water solution (2:98 v/v) and solvent B is the methanol-water solution (50:50 v/v). The injection volume was adjusted to 25 μL, the flow rate to 1 mL/min and the temperature to 30±1°C. The samples were injected in duplicate. HPLC gradient program solvent flow concentration was used in the analysis.

Phenolic compounds in white wine and must samples were identified through comparison of their retention times and UV spectra with those obtained by injection of the standard solution under the same conditions. Peak area at maximum absorbance was used for the quantification of phenolic compounds using the internal standard curve. A standard curve for each phenolic compound was constructed separately by plotting peak area (y-axis) versus the concentration of the phenolic compound (x-axis). The standard curve was fitted by linear least-squares regression (r^2 0.98). Values were reported as mg/L. The analytical method was a reproducible value of ≥92% for phenolic compounds.

2.3. Statistical analysis

The wine production was repeated three times. At each repeat, parallel white wines were prepared. Samples were taken in parallel at each step of wine production, and the results of analyzes were given as the mean ± standard deviation values of the three repeats. The wines were compared depending on process time and wine types by analysis of variance with ANOVA test using SPSS v.22 (IBM SPSS Corporation, Chicago, IL, USA) with a 95 % confidence level (a confidence interval of $\alpha = 0.95$).

3. Results and Discussion

At the beginning of fermentation, the initial numbers of *S. cerevisiae* were 6.37, 6.34 and 6.26 log cfu/ml in musts-1, 2 and 3 respectively. After 3 days of fermentation, yeast counts of white wines-1, 2 and 3 were significantly ($p<0.05$) increased to 7.49, 7.48 and 7.57 log cfu/mL respectively. *S. cerevisiae* was decreased during settling, maturation and aging periods. After aging, the final survived numbers of *S. cerevisiae* were 2.13, 2.11 and 2.09 log cfu/mL for white wines-1, 2 and 3 respectively.

3.1. Changes in pH and brix values

pH values of musts-1, 2 and 3 were determined as 3.71, 3.63 and 3.59 respectively (Table 1). After fermentation and resting, the pH values of white wines were decreased. After aging, pH values of white wines-1, 2 and 3 were slightly decreased to 3.47, 3.44 and 3.39. During maturation, there was a slight increase in the pH values of white wines due to the precipitation of tartaric acid in wine as potassium bitartrate and the cleavage of malic acid to lactic acid by lactic acid bacteria. The most suitable pH value in terms of quality of the wine (such as color, microbial, chemical and oxidative stability) should be in the range of 2.7-3.8 (TFC, 2008).

After fermentation, Brix values of white wines-1, 2 and 3 were significantly ($p<0.05$) decreased to 8.22, 8.79 and 8.64 % respectively (Table 1). During resting, maturation, and aging, Brix values of white wines were slightly decreased. After aging, Brix values of white wines-1, 2 and 3 were decreased to 7.46, 7.53 and 7.18 % respectively. There are significant ($p<0.05$) differences among the Brix values of white wines. The European Union Commission Regulation has indicated that dry wines with moderate acidity may contain no more than 9 g/L of residual sugar (Jordao et al., 2015).

Changes in alcohol and free SO_2 values. During fermentation, alcohol content of wines-1, 2 and 3 were increased to 13.15, 13.36 and 13.39% respectively (Table 2). After resting, alcohol values of wines were slightly increased and slightly decreased during maturation and aging. The final alcohol contents of white wines-

1, 2 and 3 were 13.19, 13.36 and 13.65 % respectively. Decreases in alcohol amounts may be due to the evaporation of alcohol during processes and oxidation of ethyl alcohol. According to the Turkish Food Codex (TFC, 2008), regulation for wine, the amount of alcohol by volume of wine must be at least 9% and the maximum 15%. Alcohol strengthens of wine provides warmth, sweetness, durability, and taste to the wine.

Table 1. Changes of pH and Brix during white wine production*

	pH			**Brix (%)**		
Day	Wine-1	Wine-2	Wine-3	Wine-1	Wine-2	Wine-3
Must	3.71 ± 0.01^{aA}	3.63 ± 0.02^{aB}	3.59 ± 0.03^{aC}	21.55 ± 0.05^{aA}	22.12 ± 0.03^{aB}	22.60 ± 0.02^{aC}
3	3.27 ± 0.01^{bA}	3.23 ± 0.01^{bB}	3.24 ± 0.02^{bB}	18.50 ± 0.03^{bA}	19.38 ± 0.03^{bB}	19.68 ± 0.02^{bC}
12	3.38 ± 0.02^{cAB}	3.36 ± 0.02^{cB}	3.39 ± 0.01^{cA}	8.22 ± 0.01^{cA}	8.79 ± 2.71^{cA}	8.64 ± 0.02^{cA}
19	3.33 ± 0.02^{dA}	3.35 ± 0.02^{cB}	3.37 ± 0.02^{cAB}	7.06 ± 0.02^{cdA}	7.50 ± 0.02^{dB}	7.25 ± 0.04^{cC}
64	3.49 ± 0.03^{eA}	3.47 ± 0.02^{dB}	3.56 ± 0.02^{dA}	7.21 ± 0.03^{cA}	7.40 ± 0.02^{dA}	7.03 ± 0.02^{cA}
154	3.47 ± 0.01^{eA}	3.44 ± 0.01^{eB}	3.39 ± 0.02^{eC}	7.46 ± 0.02^{cdA}	7.53 ± 0.03^{eB}	7.18 ± 0.02^{cC}

*Values are the mean±SD (n=3). In the columns, different small letters represent significant differences among pH and brix during processes. In the rows, different capitalized letters represent significant pH and brix differences among wines. They were determined by the least significant difference test at $p<0.05$.

Table 2. Changes of alcohol and free SO_2 during white wine production*

	Alcohol (%)			**Free SO_2 (mg/L)**		
Day	Wine-1	Wine-2	Wine-3	Wine-1	Wine-2	Wine-3
3	4.65 ± 0.05^{aA}	4.71 ± 0.01^{aB}	4.56 ± 0.02^{aA}	-	-	-
12	13.15 ± 0.05^{bA}	13.36 ± 0.02^{bB}	13.39 ± 0.03^{bB}	13.50 ± 1.53^{aA}	12.50 ± 0.58^{aA}	12.00 ± 1.00^{aA}
19	13.69 ± 0.02^{cA}	13.70 ± 0.02^{cB}	13.89 ± 0.04^{cA}	23.00 ± 1.00^{bA}	20.00 ± 1.00^{bB}	18.50 ± 1.53^{bB}
64	13.40 ± 0.02^{dA}	13.43 ± 0.03^{cB}	13.86 ± 0.02^{dB}	28.00 ± 1.00^{cA}	26.00 ± 1.00^{cAB}	23.11 ± 1.53^{cC}
154	13.19 ± 0.01^{bA}	13.36 ± 0.03^{dB}	13.65 ± 0.02^{bC}	24.26 ± 0.58^{bA}	23.16 ± 1.73^{dAB}	22.12 ± 1.53^{cB}

*Standartd deviations indicated in Table 1 subscript.

SO_2 has widely used chemicals in preventing the growth of undesirable microorganisms. At the end of fermentation, free SO_2 amounts of wines-1, 2 and 3 were 13.50, 12.50 and 12.0 mg/L respectively (Table 2). After aging, the free SO_2 amounts in white wines-1, 2 and 3 were 24.26, 23.16 and 22.12 mg/L respectively. Free SO_2 positively affects the aging of the wine and prevents the formation of free aldehyde. According to TFC (2009), maximum permissible free SO_2 should not exceed 30 mg/L in wine.

3.2. Changes in flavanols

The changes of flavonols contents during processing steps of white wines were given in Table 3. At the end of fermentation, (+)-catechin and procyanidin B2 contents of the white wines-1, 2 and 3 were significantly increased to 1.12, 1.17 and 1.52, and 63.05, 64.03 and 70.28 mg/L respectively. After fermentation, amounts of procyanidin B2 and (+)-catechin in white wines were 3-4 and 19-28 times greater, respectively, than musts procyanidin B2 and (+)-catechin. After aging, (+)-catechin and procyanidin B2 contents of the white wines-1, 2 and 3 were decreased to 1.12, 1.16 and 1.35 mg/L, and 60.69, 66.88 and

69.02 mg/L respectively. Oak tannins interact with wine compounds, affecting the sensorial properties. In this study, both of (+)-catechin and procyanidin B2 were significantly ($p<0.05$) increased during resting in the presence of oak chips. Procyanidin B2 and (+)-catechin can give the astringency and bitterness to the wine by the assembling with proteins and glycoprotein in the saliva. These phenolic compounds have antioxidant and color effects in the wine. The most crucial factors affecting the types of flavanols in wine are the content of grapes, grape grown area, wine production technology, a contact time of juice with grape shell, alcohol amount, fermentation temperature and aging time (Uylaser and Ince, 2008).

Table 3. Changes of flavanols during white wine production (mg/L)*

	(+) – Catechin			**Procyanidin B2**		
	Wine-1	Wine-2	Wine-3	Wine-1	Wine-2	Wine-3
Must	0.04 ± 0.01^{aA}	0.05 ± 0.01^{aA}	0.07 ± 0.02^{aA}	15.06 ± 0.10^{aA}	22.36 ± 0.28^{aB}	22.67 ± 0.32^{aB}
12	1.12 ± 0.03^{bA}	1.17 ± 0.02^{bAA}	1.32 ± 0.16^{bB}	63.05 ± 1.0^{bcA}	64.03 ± 0.40^{bA}	70.28 ± 0.54^{bB}
19	1.35 ± 0.06^{cA}	1.22 ± 0.03^{cB}	1.67 ± 0.02^{cC}	78.73 ± 0.20^{dA}	79.84 ± 0.34^{cB}	84.40 ± 0.48^{cC}
64	1.22 ± 0.03^{dA}	1.19 ± 0.03^{bcA}	1.44 ± 0.03^{bB}	65.58 ± 0.64^{cA}	69.72 ± 0.56^{bA}	76.84 ± 0.56^{dB}
154	1.12 ± 0.05^{bA}	1.16 ± 0.02^{bA}	1.35 ± 0.03^{bB}	60.69 ± 1.87^{bA}	66.88 ± 1.57^{bB}	69.02 ± 1.52^{bB}

*Standard deviations indicated in Table 1 subscript.

3.3. Changes in flavonols

The changes of flavonols contents during processing steps of white wines were given in Table 4. At the end of fermentation, myricetin contents of white wines-1, 2 and 3 were significantly ($p<0.05$) increased to 0.14, 0.16 and 0.19 mg/L respectively. After the aging, the myricetin contents of the white wines-1, 2 and 3 were decreased to 0.11, 0.13 and 0.15 mg/L respectively. At the end of fermentation, quercetin content of the white wines-1, 2 and 3 were significantly ($p<0.05$) increased to 0.62, 0.61 and 0.64 mg/L respectively. After aging, the quercetin contents of the white wines-1, 2 and 3 were 0.47, 0.50 and 0.59 mg/L respectively. At the end of fermentation, the rutin content of the white wines-1, 2 and 3 were significantly ($p<0.05$) increased to 08, 0.10 and 0.11 mg/L respectively. During resting, maturation, and aging of the white wines, the rutin contents were slightly increased. Rutin capable of chelating metal ions (such as iron) causes the formation of oxygen radicals with their high antioxidant activity. Flavonols occur as the glycoside structure of grapes. They are hydrolyzed during juice extraction and fermentation. Quercetin gives a bitter taste to the whine. Flavonol contents of wines depending on the intensity of sunlight where the grape cultured, the thickness of the grape skin, the type of grape and the technological processes applied in wine production (Jackson, 2000).

3.4. Phenolic acids

The changes of phenolic acids contents during processing steps of white wines were given in Table 5. After maturation and aging, gallic acid contents were decreased. Gallic acid is released from grapes and formed during resting with oak chips. Gallic acid gives astringency aroma. At the end of fermentation, the chlorogenic acid content of the white wines-1, 2 and 3 were significantly ($p<0.05$) increased to 7.52, 7.74 and 7.71 mg/L respectively. Final chlorogenic acid contents in white wines-1, 2 and 3 were decreased to 7.13 7.44 and 7.60 mg/L respectively.

Table 4. Changes of flavonols during white wine production (mg/L)*

	Myricetin			**Quercetin**			**Rutin**		
Days	Wine-1	Wine-2	Wine-3	Wine-1	Wine-2	Wine-3	Wine-1	Wine-2	Wine-3
Must	0.02±0.00^{aA}	0.02±0.06^{aA}	0.04±0.02^{aA}	0.22±0.02^{aA}	0.32±0.02^{aB}	0.45±0.01^{aC}	0.03±0.01^{aA}	0.03±0.00^{aA}	0.03±0.01^{aA}
12	0.14±0.02^{bA}	0.16±01^{bA}	0.19±0.02^{bB}	0.62±0.01^{bA}	0.61±0.02^{bA}	0.64±0.01^{bA}	0.08±0.01^{bA}	0.10±0.00^{bA}	0.11±0.01^{bA}
19	0.14±0.03^{bA}	0.16±0.2^{bA}	0.18±0.03^{bcA}	0.72±0.010^{cA}	0.68±0.01^{cAB}	0.68±0.02^{cB}	0.11±0.01^{cA}	0.12±0.02^{bA}	0.18±0.01^{bcB}
64	0.14±0.01^{bA}	0.15±0.1^{bA}	0.16±0.01^{cA}	0.69±0.01^{dA}	0.74±0.01^{dA}	0.74±0.02^{dA}	0.22±0.01^{dA}	0.28±0.02^{cB}	0.22±0.01^{cA}
154	0.11±0.03^{bA}	0.13±0.01^{bA}	0.15±0.02^{cB}	0.47±0.02^{eA}	0.50±0.02^{eA}	0.59±0.01^{eB}	0.32±0.02^{eA}	0.30±0.02^{cA}	0.28±0.01^{dB}

*Standard deviations indicated in Table 1 subscript.

Table 5. Changes of phenolic acids during white wine production (mg/L)*

	Gallic acid			***p*-Coumaric acid**			**Chlorogenic acid**		
Days	Wine-1	Wine-2	Wine-3	Wine-1	Wine-2	Wine-3	Wine-1	Wine-2	Wine-3
Must	3.49±0.02^{aA}	3.61±0.04^{aB}	3.48±0.03^{aA}	0.21±0.02^{aA}	0.22±0.01^{aA}	0.23±0.03^{aA}	7.17±0.04^{aA}	7.20±0.04^{aA}	7.19±0.04^{aA}
12	4.65±0.03^{bA}	3.69±0.02^{bB}	3.71±0.04^{bB}	0.66±0.02^{bA}	0.69±0.02^{bB}	0.78±0.01^{bC}	7.52±0.24^{bA}	7.74±0.04^{bB}	7.71±0.04^{bB}
19	5.04±0.05^{cA}	4.47±0.04^{cB}	4.43±0.02^{cB}	0.94±0.03^{cA}	0.76±0.02^{cB}	1.02±0.04^{cB}	7.73±0.07^{cA}	7.95±0.05^{cB}	7.88±0.04^{cC}
64	4.38±0.04^{dA}	4.35±0.04^{cA}	4.36±0.03^{cA}	1.19±0.03^{dA}	1.24±0.03^{dA}	1.31±0.04^{dA}	7.40±0.05^{dA}	7.78±0.04^{bB}	7.79±0.04^{dB}
154	4.29±0.04^{dA}	4.31±0.06^{dA}	4.33±0.02^{cB}	1.39±0.03^{eA}	1.41±0.02^{eA}	1.44±0.05^{eA}	7.13±0.07^{aA}	7.44±0.05^{dB}	7.60±0.07^{eC}

*Standard deviations recorded indicated in Table 1 subscript.

It is responsible for the sour taste in wine, easily oxidizes in the presence of polyphenol oxidase and converted to brown-colored compounds. At the end of fermentation, p-coumaric acid contents were significantly ($p<0.05$) increased to 0.66, 0.69 and 0.78 mg/L in the white wines-1, 2 and 3 respectively. The final content of the p-coumaric acid in aged white wines-1, 2 and 3 were significantly ($p<0.05$) decreased to 0.39, 0.41 and 0.44 mg/L respectively.

The hydroxybenzoic and hydroxycinnamic acids are derived from oak as well as from grapes. Together with anthocyanins, phenolic acids contribute important characteristic quality to white wines such as astringency and bitterness (Mendoza et al., 2011). The most crucial factors affecting the amount of the phenolic acid in wine are their contents in grapes, wine production technology, the contact time of shell during juice extraction, exposure time to oaks, ethyl alcohol amount, fermentation temperature and transformations during wine processes (Uylaser and Ince, 2008).

3.5. Resveratrol and tyrosol

The changes of stilbene and phenolic alcohol contents during processing steps of white wines were given in Table 6. At the end of fermentation, resveratrol contents of the white wines-1, 2 and 3 were significantly ($p<0.05$) increased to 1.57, 1.93 and 1.82 mg/L respectively. Resveratrol contents of white wines were decreased after resting, maturation and aging. Resveratrol is in the skin of the grapes, dissolves during the juice extraction and fermentation process of white wine. At the end of fermentation, the tyrosol content of the white wines-1, 2 and 3 were significantly ($p<0.05$) increased to 36.55, 37.08 and 37.33 mg/L respectively. The tyrosol contents of the white wines were decreased during resting, maturation and aging periods. Tyrosol is phenolic alcohol and it is formed due to the sugar consumption by yeast.

Table 6. Changes of tyrosol and resveratrol amounts during white wine production (mg/L)*

		Tyrosol			**Resveratrol**	
Days	Wine-1	Wine-2	Wine-3	Wine-1	Wine-2	Wine-3
Must	0.11 ± 0.01^{aA}	0.12 ± 0.02^{aA}	0.14 ± 0.03^{aA}	0.13 ± 0.02^{aA}	0.16 ± 0.01^{aB}	0.17 ± 0.02^{aB}
12	36.55 ± 0.19^{cA}	37.08 ± 0.14^{bB}	37.33 ± 0.08^{bB}	1.57 ± 0.04^{bA}	1.93 ± 0.07^{bB}	1.82 ± 0.02^{bC}
19	36.38 ± 0.12^{bcA}	36.91 ± 0.08^{cB}	36.49 ± 0.11^{cA}	1.44 ± 0.05^{cA}	1.79 ± 0.04^{bB}	1.40 ± 0.03^{cA}
64	36.21 ± 0.09^{bA}	36.33 ± 0.14^{cA}	36.67 ± 0.09^{dA}	1.36 ± 0.06^{dA}	1.49 ± 0.05^{cA}	1.37 ± 0.04^{cA}
154	36.22 ± 0.09^{bA}	34.50 ± 0.15^{dB}	36.11 ± 0.10^{eA}	1.25 ± 0.03^{eA}	1.31 ± 0.06^{cA}	1.28 ± 0.03^{dA}

*Standard deviations indicated in Table 1 subscript.

Many remarkable features were observed, such as higher phenolic contents in the white wine-3 than the others and most of the literature results. Therefore, the sensory and color properties of white wine-3 are expected to be higher than other wines. This wine was produced from 70% Dökülgen+30% Paf grapes. However, the other two wines also contain a higher amount of phenolic compounds compared with most of the literature results. Paf grape was contributed a higher amount of phenolic compounds to the white wine than Dökülgen grape. Hence, the grape variety has a significant effect on the phenolic content of wines during fermentation. The bark of Dökülgen grape is "thin-skinned" and weaker. Paf grape is "thick-skinned". Dökülgen grape was contributed more sugar (21%). Procyanidin B2 was the most abundant phenolic in the white wines, while tyrosol was the second most abundant phenolic. Many published results for white wines indicated that the main individual phenolic compounds in white wines were (+)-catechine and gallic acid. This difference might be related to the 'terroir' of the zone, water deficits, fewer temperature differences between daytime and nighttime, and infertile soil. Phenolic compounds play a

primary role in defining the sensorial characteristics of wines, giving the "oak wood" taste typical of long-aged products, besides being largely responsible for the astringency and bitterness of young wines (Bianchini and Vainio, 2003). The results showed that Dökülgen and Paf grapes are suitable for high-quality white wine production. Since these grapes contribute higher amount of phenolic characteristics, better acidity, and Brix to white wine.

4. Conclusions

Procyanidin B2, tyrosol and chlorogenic acid were significantly ($p<0.05$) higher in all white wines than the other phenolics. Phenolic acid contents of Dökülgen and Paf grapes were suitable for white wine production. White wine with higher phenolic contents will associate with high antioxidant capacity. Many of the remarkable features of the phenolic profiles and Brix of grape varieties could help us to characterize Gaziantep White wines. The results from this study provide valuable information about the white wine produced from the ancient grape variety of the South-east region. This study presents original data for phenolic compounds of Gaziantep white wines. These results could be of great interest to nutritionists and dietitians for the assessment of dietary phenolic compounds intake. However, considering the different sugar, acidy and phenolic concentrations, grape varieties will be used separately and mixtures in the production of the white wines to indicate quality characteristics and acceptability by the panelist.

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