VOLATILE AND PHENOLIC COMPOSITION OF AGIORGITIKO WINES FROM SEVEN DIFFERENT AREAS OF PDO NEMEA ZONE

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Introduction

Agiorgitiko (*Vitis Vinifera* L. cv.) is the most cultivated red grapewine variety in Greece[1] located mainly in Nemea region, the largest PDO zone in Greece[2]. Although Agiorgitiko is considered as one of the most interesting red grape varieties, not only in Greece[3], but also at international level[4,5], however, there is a lack of knowledge concerning the phenolic and aromatic profile of the Agiorgitiko varietal wines. For this study seven vineyards, from the most representative areas of the PDO Nemea zone, were selected in order to study the phenolic and aromatic potential of the variety and the heterogeneity of the wine composition among the different areas.

Materials and methods

Within the seven vineyards, vines were selected according to the same selection protocol. From the selected vineyards, 60 kg of grapes were harvested at the optimum technological maturity level using a defined picking protocol. Microvinifications were conducted, in triplicate, applying the same winemaking protocol. The produced wines were analyzed for their main oenological parameters and for their phenolic and volatile composition. All analysis for the main oenological parameters were conducted according to OIV International methods. Total anthocyanins were measured according to discoloration with SO_2 (Ribéreau- Gayon, *et al*, 1999) and total tannins according to methyl cellulose precipitation method (Sarneckis C., *et al*., 2006). Moreover, the wines were evaluated sensorially by a trained panel.

Results and discussion

The main oenological parameters are shown on Table 1. Statistical differences among alcoholic degree of wines implied the effect of pedoclimatic conditions of each vineyard.

Phenolic content of wines is presented on Table 2. Wine tannin content was relatively low for all samples with only exceptions of ID 2 and ID 4 which also exhibited the highest concentrations of total anthocyanidins. Alcoholic degree of wines had no correlation with anthocyanidin and tannin content therefore the depicted differences among the samples possibly originated from variability of each vineyard's terroir.

Samples were analyzed for 24 volatile compounds. Sum of higher alcohols, volatile acids and esters are presented on Figure 1 and Figure 2 respectively.

Higher alcohols are a major group of volatile compounds which are produced during alcoholic fermentation and transfuse a solvent odor in wines. All samples concentrations ranged from 280-395 mg/L with the highest concentration of total higher alcohols depicted on sample ID 2 and the lowest on ID 3. Fatty acids have a cheese and fatty odor and they are formed during alcoholic fermentation as yeast by-products. Sum of fatty acids of samples presented a minimum concentration on ID 1 (4,77 mg/L) and a maximum on ID 3 (8,16 mg/L).

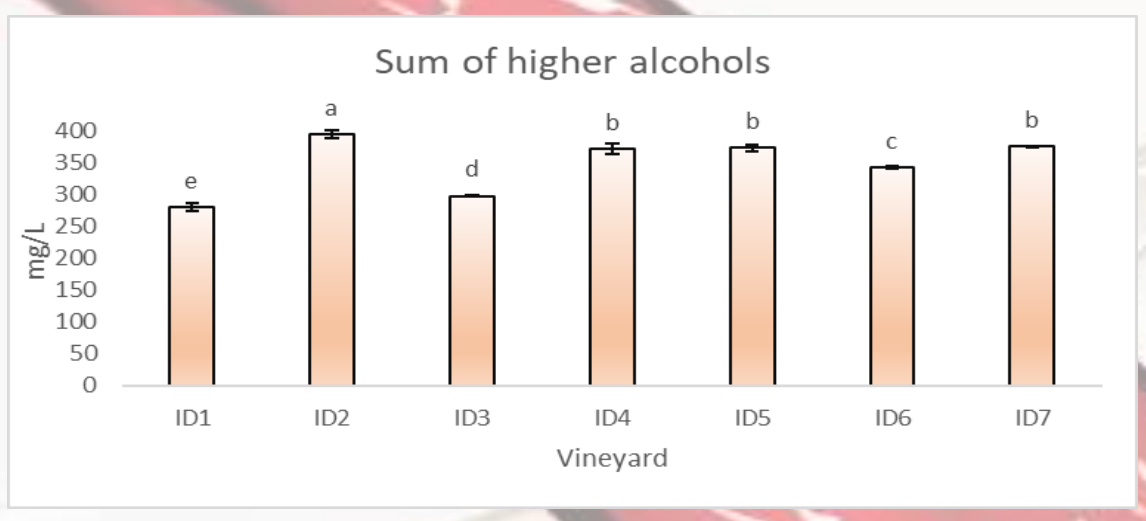

Figure 1: Sum of higher alcohols content of wines analyzed by GC/MS on mg/L.. Wines with different letters have significant statistical differences (p< 0,05, Tukey's HSD test).

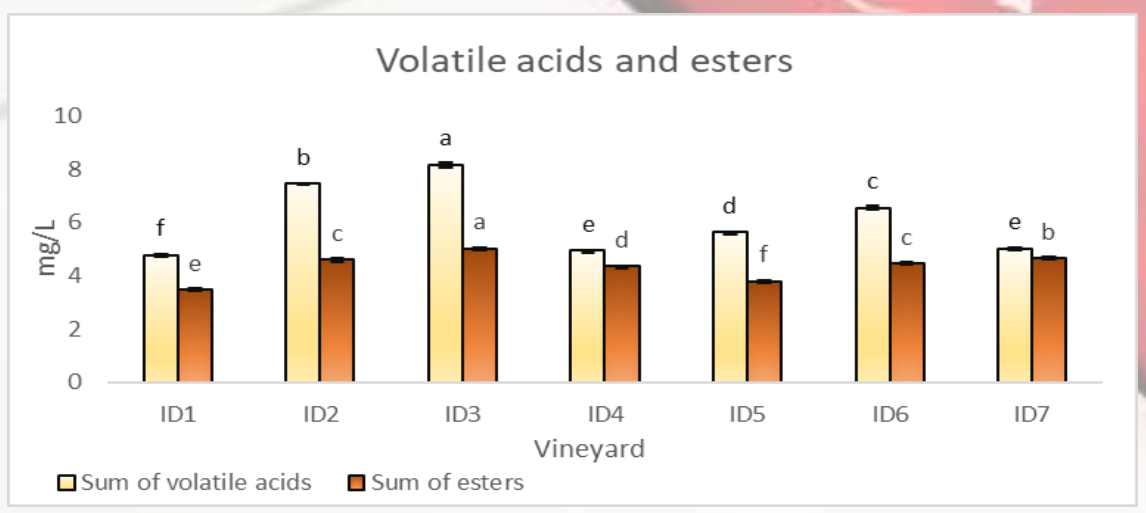

Figure 2: Sum of volatile acids and esters content of wines analyzed by GC/MS on mg/L.. Wines with different letters have significant statistical differences (p< 0,05, Tukey's HSD test).

Table 1: On Table 1 are presented the main oenological parameters of wines. Wines with different letters have significant statistical differences (p< 0,05, Tukey's HSD test)

Vineyard ID	Altitude (m)	Alcohol (% vol)	Total acidity (g/L)	pH	Volatile acidity (g/L)
1	400	12.7±0.1 b,c	6.4±0.1 c	3.64±0.03 c,d	0.45±0.02 c
2	800	12.2±0.2 e	7.4±0.1 a	3.44±0.02 e	0.55±0.02 a
3	450	13.2±0.1 a	6.7±0.1 b	3.63±0.03 d	0.53±0.03 a,b
4	240	12.5±0.1 c,d	6.1±0.1 d	3.81±0.01 a	0.50±0.01 b,c
5	600	12.8±0.1 b	6.4±0.1 c	3.71±0.01 b	0.50±0.01 b,c
6	310	13.3±0.1 a	6.5±0.1 c	3.68±0.01 b,c	0.53±0.02 a,b
7	270	12.4±0.1 d,e	6.4±0.1 c	3.63±0.03 d	0.48±0.01 c

Table 2: Table 2 presents the phenolic and anthocyanidin content of wines. Wines with different letters have significant statistical differences (p< 0,05, Tukey's HSD test)

Vineyard ID	Color Intensity (AU)	Hue (AU)	TPI (AU)	Total anthocyanins (mg/L)	Total tannins (g/L)
1	7.3±0.3 c	0.47±0.05 e	33.4±1.5 c	237.2±4.2 c	0.68±0.01 e
2	8.1±0.2 a	0.57±0.04 c,d	38.3±0.6 b	394.0±5.1 a	1.18±0.01 a
3	6.9±0.1 c,d	0.68±0.04 b	37.5±0.7 b	196.9±2.6 e	1.06±0.00 b
4	8.0±0.1 a	0.70±0.00 b	45.3±0.6 a	329.9±3.7 b	1.16±0.02 a
5	6.8±0.1 d	0.50±0.00 d,e	31.1±1.2 d	216.2±3.5 d	0.66±0.01 e
6	7.7±0.3 b	0.60±0.00 c,d	33.8±0.2 c	206.1±8.0 d,e	0.80±0.01 c
7	6.2±0.1 e	0.87±0.05 a	32.8±0.5 c	195.1±3.5 e	0.75±0.02 d

Esters are linked to fruity aroma of wines and are mainly produced during alcoholic fermentation. All of the esters that were analyzed on samples were above their odor threshold[6]. Sample ID 3 had the highest concentration of esters and sample ID 5 the lowest. The production of esters during alcoholic fermentation depends on several factors as must content (sugars, yeasts assimilable nitrogen) and fermentation conditions (temperature, oxygen availability)[7]. Since microvinifications were conducted under the same conditions, with the same protocol, the depicted differences on wine's ester content may occur by differences of must's composition.

All samples were sensorially evaluated by a 12 person (6 women and 6 men) trained panel with the use of a scale from 1 (minimum) to 5 (maximum) for each descriptor. Wines were evaluated for 6 olfactory descriptors (berries, cherry, floral, plum, sour cherry, strawberry and vanilla) and the sense of sour, bitter and astringency. Pearson's correlation depicted a correlation of TPI with the sense of bitter (0,4486 p<0,05) and astringency (0,5354 p<0,001). Total tannins also correlated with the sensorial results for the sense of bitter (0,5912 p<0,05) and astringency (0,5399 p<0,05). Concerning the olfactory descriptors, sample ID 2 had the highest score for plum and vanilla, sample ID 6 for berries, cherry and sour cherry, sample ID 5 for strawberry and sample ID 7 for floral. The olfactory descriptor for "floral" presented a strong correlation with 2-phenyl ethanol (0,7587 p<0,001) and the descriptors "strawberry" and "plum" with the sum of esters (0,5547 p<0,001 and 7166 p<0,001 respectively).

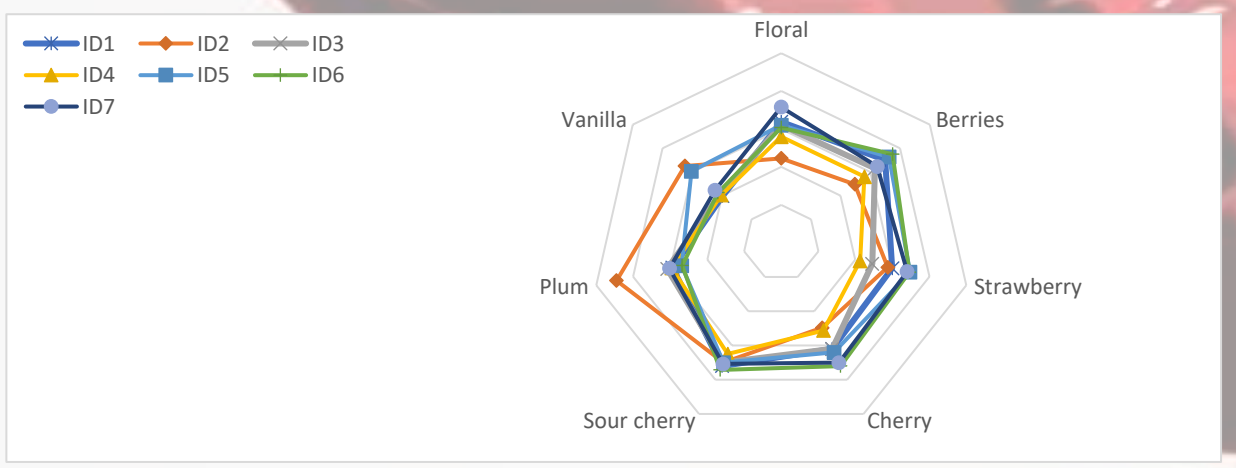

Figure 3: Mean score of sensory evaluation results of the olfactory descriptors. For all descriptors was used a scale from 1 (minimum) to 5 (maximum).

Conclusion

The present study provides a detailed approach on the characterization of the phenolic and aromatic content of Agiorgitiko wines, which is a great tool for improving the quality of the PDO Nemea wines. As it is depicted on the results tannin content of wines had an impact on sensory attributes. Also, the analysis of volatile content in conjunction with the results of sensorial evaluation of wines proposes an aromatic profile of Agiorgitiko wines. Moreover, in this study the variability of Nemea's region pedoclimatic conditions that were depicted on wines characteristics from different areas, implies the need of further research on the impact of "terroir" in Agiorgitiko wines produced from different areas.

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