

Polyphenol composition of wine from the variety Cabernet Sauvignon

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Polyphenols and their derivatives are complex compounds that are responsible for the color and quality of red wines. The goal of the research was to determine the polyphenolic composition and its influence on the color and quality of the Cabernet Sauvignon variety. Wines obtained from Skopje, Ovce Pole and Gevgelija-Valandovo regions were investigated. In young wines, chemical analysis of total polyphenols, total anthocyanins, tint and color intensity was performed. The analyses were carried out by using spectrophotometric methods and standard chemical methods. With a higher content of total polyphenols (3385 mg/L EGA) and anthocyanins (978 mg/L), the wine from Skopje wine region was distinguished. The richest chemical composition has the wine from the Ovce Pole wine region with the highest content of alcohol (14.58 vol.%), dry extract (30.8 g/L) and total acids (5.8 g/L). The polyphenolic composition of the wines depends on a number of factors: the variety-clone, the substrate, the agro-technical and ampelotechnical measures, the yield, the degree of maturity, the health condition, the harvesting and transport and the terroir.

Keywords: vineyards, Cabernet Sauvignon, wine, polyphenols, anthocyanins.

INTRODUCTION

Polyphenols and their derivatives are a large complex of compounds that are responsible for the characteristics, color and quality of the wines, especially the red wines. They are a heterogeneous family composed of two main groups: flavonoids and non-flavonoids. Flavonoids in grapes and wine are mainly found as: anthocyanins, flavonols, flavan-3 ols (tannins or proanthocyanidins) [1, 2]. Non-flavonoids include phenolic acids and stilbenes. Polyphenols significantly affect the sensory characteristics of both, the grapes and the wine, since they are responsible for some organoleptic properties such as: aroma, color, bitterness and astringency. Thus, the anthocyanins are responsible for the color of red wines, while proanthocyanidins, which are still called condensed tannins, are responsible for the bitterness and astringency of the wines. The polyphenolic structure of the wines depends on a number of factors and can be divided into: unchangeable (constant) and variables. Invariable factors are: variety-clone, basis, soil and location. The group of variable factors includes: climatic conditions, agro-technical and ampelotechnical measures, yield, level of maturity, health condition, manner of harvesting and transport. Terroir has a major influence on the quality of grapes and wine [3, 4]. Defining the terroir conditions includes: soil, subsoil, microclimate, orography, exposure, level and composition of subsoil waters. The listed elements of the terroir give the specificity of the

wines originating from the existing conditions. The soil types influence the choice of the substrate, the variety and the quality of the grapes and the wine. Climate conditions (temperature, precipitation and insolation) during the year of production have the biggest impact on the quality of the grapes. The Skopje, Ovce Pole and Gevgelija-Valandovo wine areas, according to climatic characteristics, are in the continental-sub-mediterranean climate. The Skopje wine region is a typical area where the influence of the sub-mediterranean and eastern continental climate is combined [5].

Both the distance from the Aegean Sea and the proximity to the higher mountains contribute to the climate in this area, to be less homogeneous with pronounced variations of certain climatic elements. Ovce Pole and Gevgelija-Valandovo wine areas are characterized by a warmer climate and more sub-mediterranean influence. Climatic conditions have an impact on the variety and quality of the grapes (raw material) for wine production. Years of production in developed wine-growing countries on the basis of climatic conditions and quality of harvesting of the wines are declared as: good, very good and excellent. The warm climate conditions with an average annual air temperature of 11.5 °C-12.5°C, with vegetation temperature amount of 3800°C - 4000°C and precipitation up to 600 mm, are generally acceptable for the production of wine varieties such as Cabernet Sauvignon, Burgundy Black, Merlot and others. They provide a raw material for the production of red dry and intensively colored wines.

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MATERIAL AND METHODS

The tests were carried out with the variety Cabernet Sauvignon grown in three vineyards: Skopje, Ovce Pole and Gevgelija-Valandovo. The grape variety Cabernet Sauvignon was simultaneously taken up in full technological maturity from the three vineyards. Its processing was carried out in the experimental winery at the Agricultural Institute-Skopje. The grape pulp was treated with sulfides (with 50 mg/L). The maceration lasted 7 days and the fermentation was carried out at 25 ± 2 °C for a duration of 10 days. For more efficient extraction of the phenol components in the grape pulp, 3ml/HI enzyme and 25g/HI wine yeast were added. After fermentation, the wine was separated from the sediment and correction of SO₂ was made. So, the free SO₂ is not less than 25 mg/L and the total SO₂ is not higher than 100 mg/L. After that the wine was packed in bottles. Packaged wines were kept at 15 ± 2 °C temperature with adequate care. In the obtained young wines alcohol, total extract, sugar, total acids, volatile acids, free and total SO₂ and pH were measured at an accredited oenological laboratory of the Agricultural Institute-Skopje, according to the adopted methods of OIV. [5, 7, 11] Analysis of total polyphenols was performed according to the method of Folin-Ciocalteu, following the procedure below:

The wine sample was diluted 1/25. Then 5 mL of distilled water and 1 ml of the diluted wine were put in a 10 mL volumetric flask. 0.5 mL of Folin

Ciocalteu's reagent and 1.5 mL of Na₂CO₃ (20% solution) were added to the solution and after 3 min the volumetric flask was filled up to the mark with distilled water. Then the solution was left in a water bath for 16 min at 50°C. The colored samples were analyzed spectrophotometrically, at a wavelength of 765 nm. The obtained results are expressed in mg/L EGA (Equivalents galic acid) [6, 7]. For determination of anthocyanins, tint and intensity of the wine, it was necessary to centrifuge it, with 5000 revolutions per minute, with duration of 30 min. Centrifuged wine was diluted 1/100 with acidified ethanol (ethanol + concentrated HCl) [11, 12]. The diluted samples were analyzed spectrophotometrically, at a wavelength of 420, 520 and 550 nm. The values were obtained using the formulas for anthocyanins, nuance and intensity. Sensory assessment of guilt was performed by a five-member tasting committee.

RESULTS AND DISCUSSION

The chemical composition of the grape must is represented by: sugar content, total acidity content and pH. The lowest sugar content was registered in the sample of the Skopje wine area (215.0 g/L) and the highest value was obtained in the sample from the Ovce Pole region (245.0 g/L) [7, 10]. The Ovce Pole wine district was characterized by the highest total acid content (7.0 g/L). With the lowest content of total acid were the samples from Gevgelija-Valandovo wine region (5.7 g/L). The obtained results of the chemical composition of the must are shown in Table 1.

Table 1. Chemical composition of must

| Parameter | Skopje region | Ovce Pole region | Gevgelija-Valandovo region |
|-------------------|---------------|------------------|----------------------------|
| Sugar (g/L) | 215.0 | 245.0 | 220.0 |
| Total acids (g/L) | 6.7 | 7.0 | 5.7 |
| pH | 3.43 | 3.35 | 3.61 |

Table 2. Chemical composition of wine

| Parameter | Skopje region | Ovce Pole region | Gevgelija-Valandovo region |
|------------------------------|---------------|------------------|----------------------------|
| Alcohol (vol%) | 12.68 | 14.58 | 13.00 |
| Total extract (g/L) | 29.70 | 30.8 | 28.9 |
| Sugar (g/L) | 1.0 | 1.0 | 1.0 |
| Total acids (g/L) | 5.7 | 5.8 | 4.9 |
| Volatile acids (g/L) | 0.56 | 0.34 | 0.42 |
| Free SO ₂ (mg/L) | 26.88 | 30.00 | 25.40 |
| Total SO ₂ (mg/L) | 70.40 | 64.00 | 52.04 |
| pH | 3.19 | 3.30 | 3.45 |

The following parameters were examined for the obtained wines from all three vintages: alcohol, total extract, sugar, total acids, volatile acids, free and total SO₂, pH, total phenols, anthocyanins, tint and intensity (Table 2). The highest content of alcohol (14.58 %) was obtained for the wine sample from Ovce Pole region. The content of total acids varied from 4.9 to 5.7 g/L which is within the permissible limit for quality red wine. The obtained results for volatile acids from 0.34 to 0.56 g/L indicated that they are microbiologically healthy wines [8, 9]. According to the content of the total extract (28.9 to 30.8 g/L) the wines are tasty and with high quality. The obtained values for total phenols, anthocyanins, tints and intensities in the young wine are shown in Table 3. The content of total phenols is variable. The result obtained for the wine sample from Skopje region is the highest (3385.00 mg/L EGA) and the lowest value (2342.00 mg/L EGA) is obtained for the sample from Gevgelija-Valandovo vineyard. The results for anthocyanins, from 422.77 to 978.84 mg/L EGA, for the samples from Gevgelija-Valandovo and Skopje, respectively, are shown in Table 3. The tint value (0.3265-0.3640) is within the permissible limits for young red wines. Its increase depends on storage and ripening period of the wine. The intensity (1.0155-1.3265) is within the allowed limits for young red wines, it has a variable character, decreases during maturing and aging of the wine.

Young wines from Cabernet Sauvignon varieties are of intense red color, with an odor that resembles to currant, blackberry, green pepper and other less pronounced spicy aromas. As a result of the higher content of tannins in the grapes, the young wine of taste is slightly coarse (mandatory longer maturation). Fully formed and ripened wine from the Cabernet Sauvignon variety is distinctive with a specific taste, intense color, light, harmonious.

Table 3. Phenolic compounds in wine

| Parameter | Skopje region | Ovce Pole region | Gevgelija-Valandovo region |
|--------------------------|---------------|------------------|----------------------------|
| Total phenols mg/L (EGA) | 3385.00 | 3020.00 | 2342.00 |
| Anthocyanins mg/L (EGA) | 978.84 | 732.42 | 422.77 |
| Tint | 0.3640 | 0.3265 | 0.3397 |
| Intensity | 1.2570 | 1.3265 | 1.0155 |

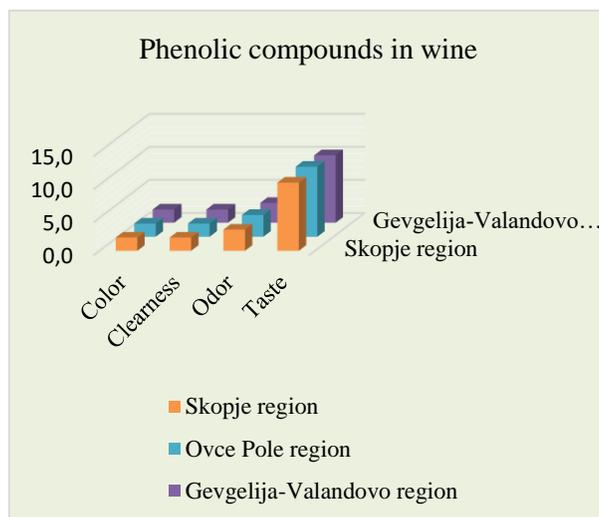


Chart 1.

Table 4. Sensory evaluation of the wine

| Parameter | Skopje region | Ovce Pole region | Gevgelija-Valandovo region |
|-----------|---------------|------------------|----------------------------|
| Color | 2.0 | 2.0 | 2.0 |
| Cleanness | 2.0 | 2.0 | 2.0 |
| Odor | 3.2 | 3.3 | 3.0 |
| Taste | 10.3 | 10.6 | 10.2 |
| Total | 17.5 | 17.9 | 17.2 |

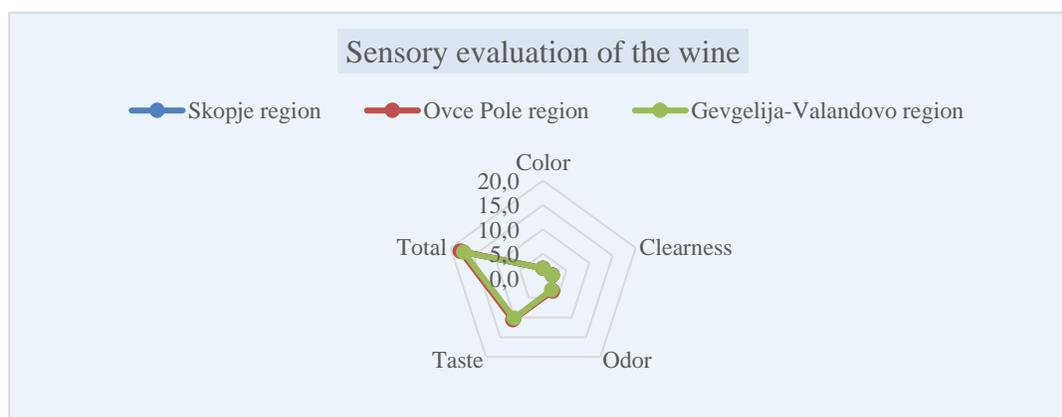


Chart 2.

In assessing the guilt, 4 parameters (color, clearness, odor and taste) were taken, which form the total tasting assessment. The maximum number of points is 20. The best quality and the highest sensory score (17.9) was evaluated for the wine from Ovce pole region. The lowest points had the wine from Gevgelija-Valandovo region (17.2 points). The results of the sensory evaluation of the guilt are presented in Table 4.

CONCLUSIONS

On the basis of the obtained results and performed tests on the Cabernet Sauvignon variety, the following conclusions can be made:

- Climatic and soil conditions in the Skopje, Ovce Pole and Gevgelija-Valandovo vineyards are very favorable for successful breeding of Cabernet Sauvignon. It provides a raw material for the production of quality and premium wines. It is recommended for growing in all the wineries of the Republic of Macedonia.

- The sugar content (215.0 - 245.0 g/L) and total acids (5.5-7.0 g/L) in the must are within the biological properties of the variety.

- The wine is characteristic for the variety Cabernet Sauvignon, it has a rich chemical composition: alcohol (12.68- 14.58%), total extract (28.9 to 30.8 g/L), total acids (4.9-5.8 g/L), anthocyanins 422.77-978.84 mg/L) and total phenols (2342.0-3385.0 mg/L EGA).

The best quality and highest sensory evaluation was established for the wine from Ovce Pole Vineyard.

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