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DETERMINATION OF COLOR AND ANTHOCYANINS IN THREE ROMANIAN RED WINES

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Abstract. *In this study UV-VIS spectrophotometer and CM 700 D spectrophotometer - KONICA MINOLTA Colorimeter (CieLab Method) were used to investigate the anthocyanins content and color of three Romanian red wines. The samples were purchased from three different Romanian vineyards located in different regions of the country (South East Development Region (SEDR), South-Muntenia Development Region (SMDR) and South West Oltenia Development Region (SWODR)). In total, nine samples of red wine Feteasca Neagra, Cabernet Sauvignon and Merlot, the harvest of 2012, were analyzed. During this study chromatic parameters as L *, a *, b *, C * and H0 were determined. The degree of brightness is indicated by the L * parameter and according to our results it is between 0.27 (darkest) for Merlot wine from the Vineyard located in South West Oltenia Development Region and 15.48 for the Feteasca Neagra wine from the Vineyard located in South-Muntenia Development Region. The results showed that chromatic parameter a, located on the color coordinate red-green, has values ranging from -0.09 (Feteasca Neagra from SMDR) and 1.47 (Cabernet Sauvignon from SMDR). The highest total anthocyanins content of the Feteasca Neagra wine was recorded in the vineyard located in the SWODR (251 mg/L), followed by the vineyard located in the SEDR, and the lowest content (97 mg/L) was recorded for the wine from the vineyard located in the SMDR. Feteasca Neagra, Cabernet Sauvignon and Merlot wines have different anthocyanins content from one vineyard to another, demonstrating that the variation of anthocyanins and implicitly variation in wine color is influenced by pedo-climatic conditions in the area, cultivated varieties and vinification technology applied.*

Keywords: anthocyanins, CieLab Method, red wine, vinification

1. Introduction

Wine is a *drink obtained exclusively from the complete or partial alcoholic fermentation of fresh or crushed fresh grapes or of fresh grape must* [1]. In 2015, the global grape production was 75 million tons, out of which 71% was used in the wine industry and 29% was consumed as fresh and dried fruits. 127.8 million hl of red wine were produced in the world. This quantity represents 46% of the total wine produced globally. In Europe, in 2015, 19.83 million tons of red grapes and 90.59 million hl of red wine were produced. In the same year, revenues of 23.83 billion euros from red winemaking were recorded. Among the global largest wine producers, Romania was ranked 13th [2], while in the EU was ranked 6th (Fig. 1a). The largest wine producers in the EU are France, Italy and Spain according to [3]. Production and consumption of Romanian wine between 2011 and 2019 are illustrated in the Fig. 1b. It can be seen that the highest production of wine was obtained in 2013 [2]. Romanian wine, with an average of 20 L/capita [4], is the second most consumed alcohol after beer (average of 80 L/capita) [5]. The wine quality in EU is classified in

two categories Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI). Fig. 1c illustrates the evolution of Romanian wine opening stocks by these two categories. It can be observed that in the period 2010 – 2018 the highest amount of wine was registered in the year 2016, for both wine categories [6]. As it was expected the highest revenue (Fig. 1d) from wine production was registered in the year (2013), with the highest amount of wine produced. In 2015, 40 million of euros were registered from Romanian red wine production [2]. Merlot and Cabernet Sauvignon are the leading red varieties in Romania, while Feteasca Alba and Feteasca Regala are the main white varieties [7].

One of the most significant attributes of red wine is color which is formed during winemaking due to the presence of anthocyanins. There are many studies on anthocyanins determination and color investigation of wine. For examples, [8] determined the anthocyanins and color of 173 commercial red wines from Pinot noir, Merlot, Cabernet Franc, Cabernet Sauvignon varieties. Organic and inorganic compounds of eight Pinot Noir red wines were investigated by [9]. They determined anthocyanins and phenolic compounds and also other chemical compounds. Anthocyanins and wine color were analyzed by [10] in different stages starting from pressing, to two, six, twelve and thirty-six months of bottle aging. In order to determine the effect of hydroxycinnamic acids on anthocyanin co-pigmentation and color of the Merlot wine, fresh and stored for six months, was examined by [11]. Parameters like color components are important due to the fact that they are contributors to sensory characteristics and antioxidant properties of wine [12]. Quality red wines are wines obtained from black grapes and have outstanding sensory characteristics as compared to other wines. The technological scheme for obtaining red wines is illustrated in the Fig. 2.

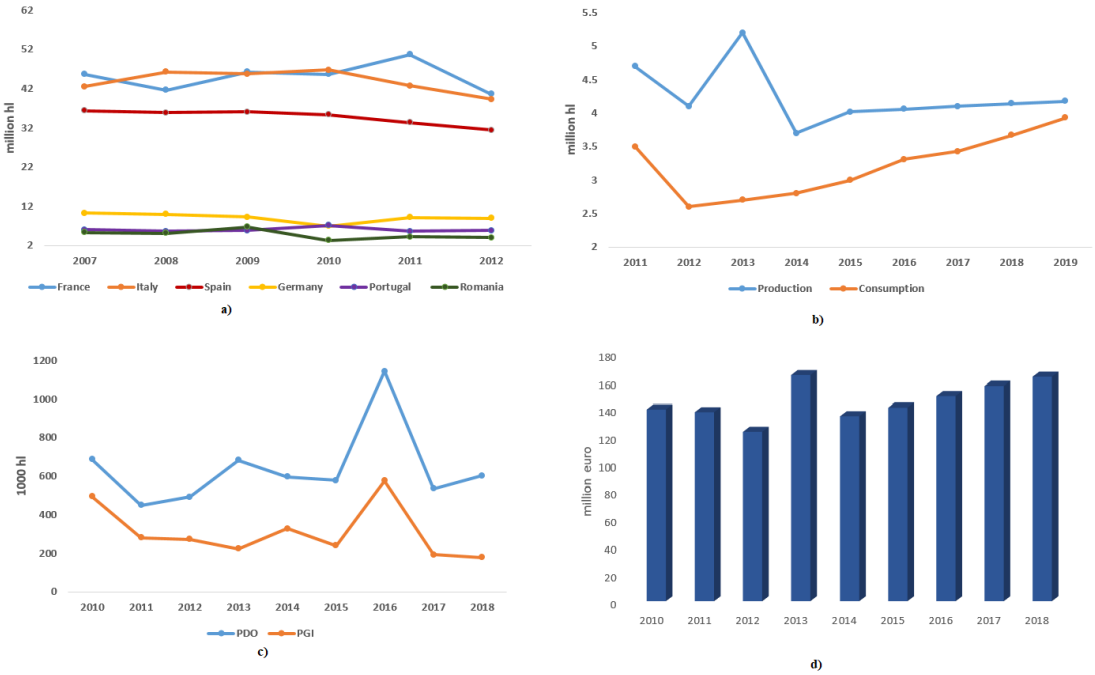

Fig. 1. a) Wine production in the EU countries; b) Production and consumption of Romanian wine; c) Evolution of Romanian wine opening stocks by category; d) Romanian wine production value (according to [2, 3, 6])

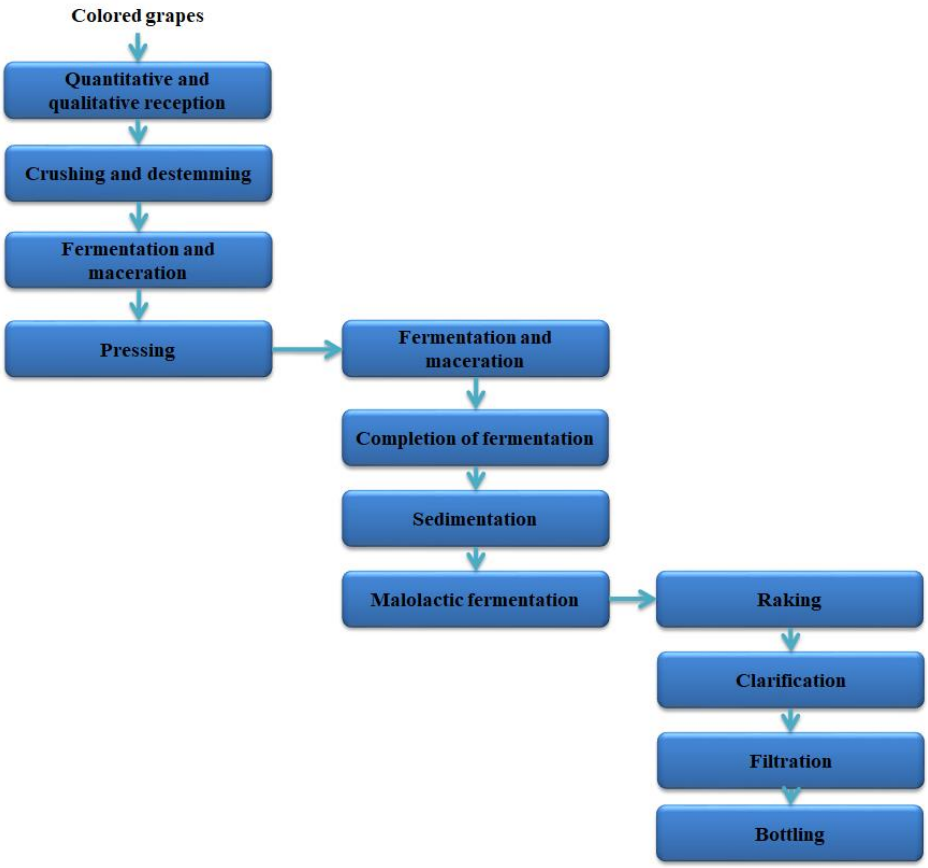

Fig. 2. Technological scheme of obtaining red wines [13]

According to [14], the consumption of anthocyanins leads to a lower risk of developing cardiovascular diseases and cancer.

The aim of this paper was to investigate the anthocyanins content and color of red wines from three different Romanian vineyards.

2. Materials and methods

The anthocyanins content and color of red wines were investigated by using UV-VIS spectrophotometer and CM 700 D spectrophotometer - KONICA MINOLTA Colorimeter (CieLab Method). Nine samples of red wine Feteasca Neagra, Cabernet Sauvignon and Merlot, harvest of 2012, purchased from three different Romanian vineyards (South East Development Region, South-Muntenia Development Region and South West Oltenia Development Region) were analyzed.

The color analysis of wine takes into consideration 5 chromatic parameters: L *, a *, b *, C * and H0:

- L * = the brightness or brightness of the color corresponds to the light transparency and varies in inverse with the color intensity of the wine. The values are between 0 (black) and 100 (white);
- a * = chromatic component of complementary colors, red-green. Values are between -100 (green) and +100 (red);
- b * = chromatic component of complementary colors, yellow-blue. Values are between -100 (blue) and +100 (yellow);
- C * = saturation or chromaticity of color corresponding to the dominant wavelength (λ) of the absorbed radiation.

The values go from scratch for very low colors and reach 141 for very intense colors.

- H0 = azimuth angle, which characterizes the hue / color tone (00-510 red wines, 520-800 purple wines)

[15, 16] also used CieLab Method for determination of red wines color. The CIELab parameters are specified by the International Organization of Vineyard and Wine (OIV) to determine the wine color [17].

The total anthocyanins content in wines was determined by applying the method proposed by [18]. Anthocyanins content was calculated based on cyanidin-3-glucoside. The absorbance of wine samples was measured at 657 nm and at 530 nm using a UV-VIS spectrophotometer. In order to correctly read the absorbance, a dilution (50/50) was made for Cabernet (from South East Development Region), Cabernet (from South West Oltenia Development Region), Merlot (from South East Development Region) and Merlot (from South West Oltenia Development Region). UV/VIS spectrophotometry for determination of anthocyanins was also used by [8, 9, 11, 19, 20], whose measurements were performed at 520 nm; while [21-23] applied HPLC method to determine these chemical compounds. [24] measured the total anthocyanins content by applying UV/VIS spectrophotometry (520 nm), and the individual anthocyanins by using HPLC. [25] mention that cyanidin-3-glucoside can be determined at 520 nm, but also at 510 or 530 nm depending on the solvent system used.

3. Results and discussion

The highest total anthocyanins content of the Feteasca Neagra wine was recorded in the vineyard located in the South West Oltenia Development Region (251 ± 25 mg/L), followed by the wine from vineyard from South East Development Region, and the lowest content (97 ± 25 mg/L) was recorded in the wine from the vineyard located in the South-Muntenia Development Region (Fig. 3). The values of anthocyanins content determined for the Cabernet Sauvignon were between: 247-537 mg/L. 184-500 mg/L anthocyanins were registered for Merlot wine. The values obtained by us are similar to those of the literature.

The Total monomeric anthocyanin content determined by [11] for Merlot wine produced in the southern Greece was 418.9 ± 4.6 mg/L. The total anthocyanins content for Cabernet Sauvignon, year 2012, determined by [20] was 341.7±34.32 mg/L for the wine Recas wineries and 258.8±10.29 mg/L for the wine from Minis wineries. Values between 572.8 and 588.9 mg anthocyanin/L wine were obtained for Romanian Wine Merlot, while for Cabernet Sauvignon there were determined the following ones: 372.7 and 401.2 mg/L, both wines were obtained by [26] from Recas vineyard. The total anthocyanins obtained by [27] for Cabernet Sauvignon, Merlot and Feteasca Neagra wines produced in Murfatlar, 2013 harvest, were: 466.37, 259.96, 325.92 mg/L. According to [10], at pressing the wine anthocyanin concentration was 403 mg/L and decreased with aging.

The results show that *L* * parameter which indicates the degree of brightness, is between 0.27 (darkest) for Merlot wine from the Vineyard located in the SWODR and 15.48 for the Feteasca Neagra wine from the Vineyard located in the SMDR, while chromatic parameter *a*, located on the color coordinate red-green, has values ranging from -0.09 (Feteasca Neagra from SMDR) and 1.47 (Cabernet Sauvignon from SMDR). The chromatic parameter *b*, based on blue-yellow colors, ranges from -0.15 (Cabernet Sauvignon from Vineyard located in the SWODR) and 0.33 (Feteasc㠎

Neagră from the Vineyard located in the SWODR) (Fig. 4).

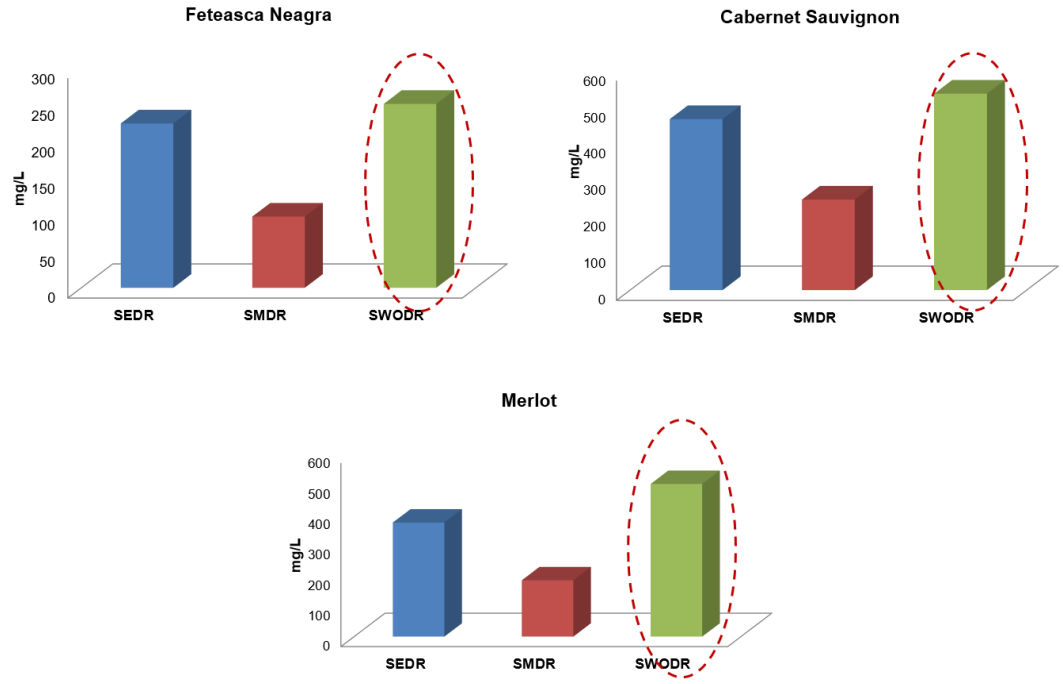

Fig. 3. Content in anthocyanins of the investigated wine samples

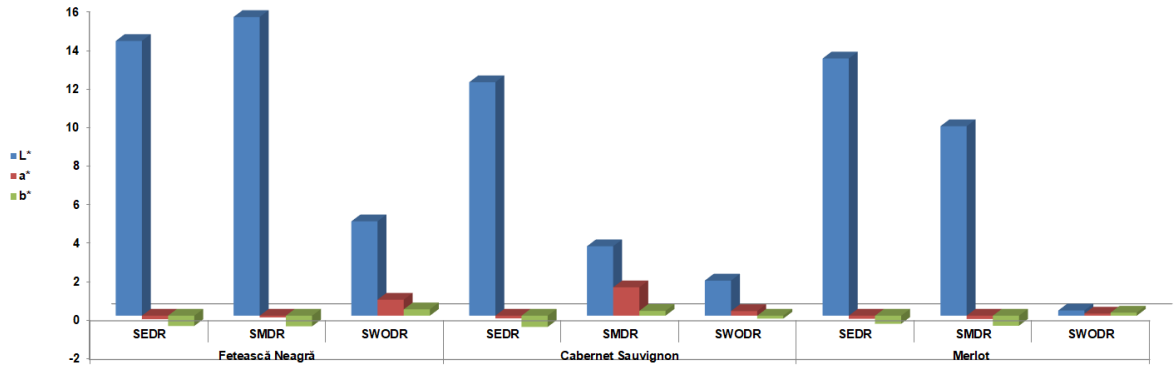

Fig. 4. Values obtained for chromatic parameters: L *, a *, b *

3. Conclusion

Feteasca Neagra, Cabernet Sauvignon and Merlot wines have different anthocyanins content from one vineyard to another, demonstrating that the variation in anthocyanins and implicitly variation in wine color is influenced by pedo-climatic conditions in the area, cultivated varieties and vinification technology applied (use of enzymes, maceration conditions and fermentation temperature) and aging. Among these factors, maceration conditions have the greatest impact on anthocyanins and sensory characteristics of red wines.

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