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THE VARIABILITY OF THE ANTIOXIDANT CAPACITY OF RED WINES IN RELATION WITH GRAPEVINE VARIETY

Aurelia TUDORACHE, Elena BRÎNDUȘE, Roxana PORUMB

Research and Development Institute for Viticulture and Enology, Valea Calugareasca,
1 Valea Mantei Street, Valea Calugareasca, zipe code 107620, Prahova, Romania

Corresponding author email: liliaur57@yahoo.com

Abstract

The red wine is one of the foods rich in antioxidants, compounds that protect the organisms against the destructive action of the free radicals on the health. In this context, for the promotion of wines on markets, an identification of the wines assortments with high antioxidant capacity should be achieved. The present study, performed during 2012– 2014 period, at Research and Development Institute for Viticulture and Enology Valea Calugareasca, aimed to define the antioxidant capacity of the wines made from 11 grapevine varieties belonging to the three groups of wines assortments and to make a correlation of the antioxidant capacity with the phenolic potential of the grapes and wines. Depending on the period when the grapevine variety was created, an old wine assortment, a current and a newly created one can be differentiated. The antioxidant capacity of the wine was performed by means the TEAC method, the phenolic potential of the grapes by Glories method and the phenolic composition of the wines by OIV spectrophotometric methods. The data processing was realized by using the Regression and correlation analysis. The obtained results showed that the varieties 'Negru aromat', 'Novac' and 'Olivia' are characterized by a high antioxidant capacity, the group formed by 'Feteasca neagra', 'Pinot noir' and 'Merlot' showed a medium antioxidant capacity. The lowest values of the antioxidant capacity were registered in the case of 'Negru moale', 'Negru vartos', 'Blauerzweigelt' and 'Burgund' mare varieties. The antioxidant capacity of the wines was closely correlated with the following parameters of the phenolic potential of the raw material: total polyphenols, extractable anthocyanins, tannins originated from seeds and the maturity of the seeds.

Key words*: antioxidant capacity, phenols, wine, grape, grapevine variety*

INTRODUCTION

Grape and wines are an important source of natural antioxidants (Kanner et al., 1994). Different wines have different quantities and spectra of native antioxidants and therefore different health benefits. Wine composition, including the contents of phenolic compounds, varies markedly depending on the grape cultivar, soil, nutrition, climatic conditions, conditions of grape maturation, winemaking procedure and conditions of wine maturation and storage.

Antioxidant activity of grapes and wine had been studied all over the world and varieties with high antioxidant capacity were identified: 'Pinot Noir', 'Merlot', 'Chardonnay', 'Cabernet Sauvignon' and 'Malbec' varieties (Landrault et al., 2001; Mitic et al, 2012; Kostadinovic et al, 2012 etc).

The relationship between the antioxidant activity and polyphenolic compounds in wines has been studied by many scientists (Cano Lario and Guerrero, 1999; Arnous and Makris, 2002).

The present study, performed during 2012–2014 period at Research and Development Institute for Viticulture and Enology Valea Calugareasca (IC-DVV), aimed to define the antioxidant capacity of the wines made from 11 grapevine varieties belonging to the three groups of wines assortments and to make a correlation of the antioxidant capacity with the phenolic potential of the grapes and wines.

MATERIALS AND METHODS

Materials

All varieties used were *V. vinifera s*pecies, harvest 2012. Eleven varieties were chosen from the collection of the (ICDVV). Five varieties, 'Cabernet Sauvignon', 'Merlot', 'Feteasca neagra', 'Pinot noir' and 'Burgund' mare represent the current assortment located in the appellation of controlled origin (AOC) Dealu Mare - Valea Calugareasca vineyard, two varieties ('Negru moale' and 'Negru virtos')

belong to the old Romanian wine assortment and three varieties ('Negru aromat', 'Olivia' and 'Novac') are Romanian newly research creation. 'Blauerzweigelt' is a variety recently introduced in the viticultural area from the world's assortment. Details about the cultivars and their location are given in Table 1.

Table 1. Variety and origin of the wines tested

Codes	Cultivar	Location
BM	Burgund mare	National Collection
BL	Blauerzweigelt	National Collection
CS	Cabernet Sauvignon	National Collection
FN	Feteasca neagra	National Collection
ME	Merlot	National Collection
NA	Negru aromat	National Collection
NM	Negru moale	National Collection
NV	Negru virtos	National Collection
NO	Novac	National Collection
OL	Olivia	National Collection
PN	Pinot noir	National Collection

Sample preparation

The grapes used for the production of the experimental wines were harvested at optimum technological maturity, as judged by indices of ripening and indices of the phenolic maturity. All the tested wines were produced in the winery of the ICDVV under similar oenological practices and stored in the same conditions. Crushed grapes stayed in contact with the must for six days at 28–30°C.

Antioxidant capacity (CAO)

All samples were analyzed in April in the year following the vintage (2012). Antioxidant capacity was determined by scavenging of the radical 2,2,-azino-bis (3-ethylbenzothiazoline) - 6 sulfonic acid (ABTS+), as described by Re et al. (1998). Stock solution was prepared by stirring ABTS (7 mM) and potassium persulfate (2.45 M) aqueous solution and allowing the mixture to stand in the dark at room temperature for 18-24 hours before use. This solution was diluted in ethanol to obtain an absorbance of 0.7 at 734 nm. In the assay, 100 µl of wine, diluted 1:100, 2500 µl ABTS and 100 µl distilled water were mixed. The absorbance at 734 nm was determined after 3 min. For each extract, a blanc with 2500 µl ABTS and 500 µl distilled water, was included to correct for any sample absorbance at 734 nm. Trolox (6-hydroxy-2,5,7,8- tetramethyl - chroman-2-carboxylic acid) was used as a standard. The antioxidant capacity was expressed as µM trolox equivalents (TE) per 100 ml.

Phenolic composition

For the determination of the total content of polyphenolic compounds in wines the DO280 index was considered: wine was diluted with distilled water (1:100) and the absorbance was measured directly at 280 nm. The value of DO280 index for each sample was given as the absorbance multiplied by the proper dilution rate.

The determination of catechins (flavan 3-ols) is based on the reaction of the phloroglucinol ring with vanillin, that produces a red colour with a maximum absorption at 500 nm (Pompei and Peri, 1973).

The anthocyans were measured using the method of Ribereau-Gayon and Stonestreet (1965).

Phenolic maturity of the grapes at harvest

The phenolic maturity of the grapes is defined as a moment when the tannins in seeds and the concentration of anthocyanins in the grape skin are minimum and maximum values, respectively. It was evaluated according to the Glories method (Anneraud and Vinsonneau, 2009), by using the following parameters: Total Polyphenol Index (ITP), Anthocyanines extractibility (AE), Contribution of grape seeds tannins (MP) and Contribution of grape skins polyphenols (MS).

RESULTS AND DISCUSSIONS

The antioxidant level of the wines from the old and new red wine assortment

The wines from the studied assortment had a medium value of the antioxidant capacity of 1808 µM TE/100 ml wine, which varied between 1181 and 2600 µM TE/100 ml. The identification of the antioxidant level of wines, namely low, moderate or high, is very important in the evaluation of wines from pharmacodynamic point of view. For this purpose, based on the obtained information, three classes of variation of the antioxidant

capacity of wines were defined, the class range being of 570 µM TE/100 ml. The antioxidant level was identified for each sample of wine. The richest in antioxidants have been 'Olivia', 'Negru aromat' and 'Novac' wines. The wines 'Negru moale', 'Negru virtos', 'Blauerzweigelt', 'Burgund mare', 'Cabernet Sauvignon' and 'Merlot' presented a low CAO value and Feteasca neagra' and 'Pinot noir' wines a moderate one (Figure 1).

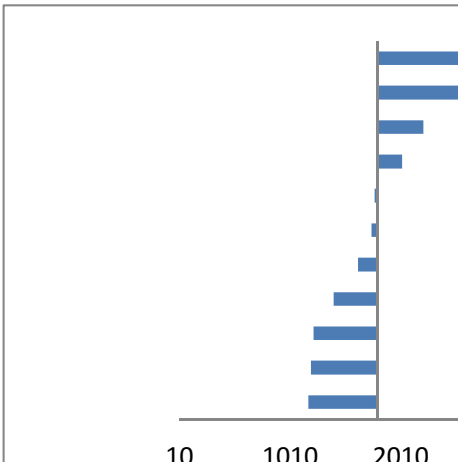

Figure 1. The ranking of red wines from the old and new assortment function of CAO

The correlation between the antioxidant capacity and the phenolic compounds

The phenolic compounds are involved in the antioxidant capacity of wines. The setting of the relationship between the antioxidant capacity of wines and their polyphenolic composition is important for the organization of the winemaking process. The analysis of linear regression CAO-total polyphenols (DO 280) showed a strong relation between the two parameters (R^2=0.77) (Figure 2).

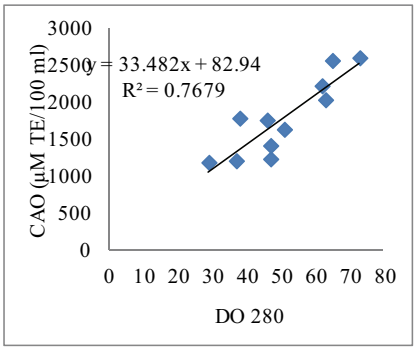

Figure 2. The correlation between CAO and DO 280

The increasing of the DO280 index by one unit determined the upwards changing of the antioxidant capacity with 33 µM TE/100 ml. The anthocyanins are in a weak relationship with the antioxidant capacity (R^2=0.29) (Figure 3).

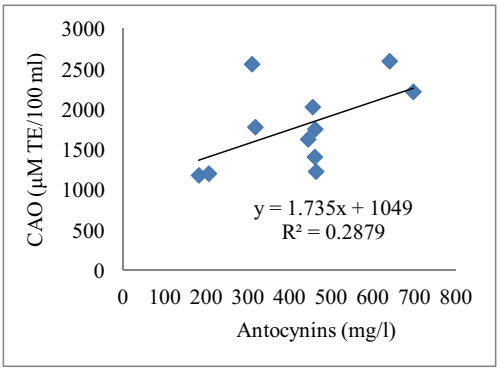

Figure 3. The correlation between CAO and anthocyanins

A strong correlation with the antioxidant capacity of wines was put into evidence at the catechins and tannins level (R^2=0.77) (Figure 4 and Figure 5).

When the amount of catechins increased with 100 mg/l, the antioxidant capacity was raised by 51 µM TE/100 ml. The increasing of tannins value by 1 g/l determined the upwards changing of the antioxidant capacity with 706 µM TE/100 ml.

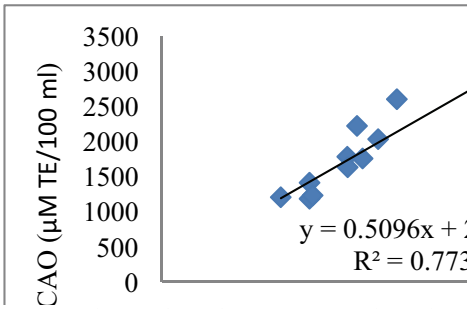

Figure 4. The correlation between CAO and catechins

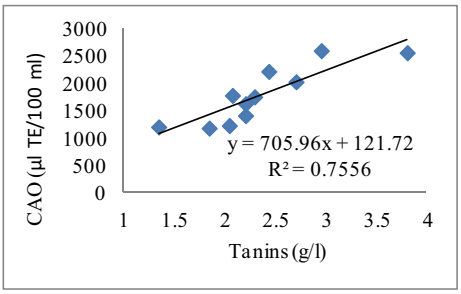

Figure 5. The correlation between CAO and tannins

The correlation between CAO and the phenolic maturity of grapes

The evaluation of the relationship between CAO and the phenolic maturity of grapes is essential to determine the optimal harvest time and for the establishing the correct vinification technique. The analysis of the multiple dependence between CAO and the parameters of the phenolic maturation of grapes (ITP, AE, MP and MS) put into evidence a strong correlation (R^2=0.89).

The regression equation (1) had the following parameters included in Table 2:

CAO=-8070+31ITP+0.10AE+8516MP+7618MS (1)

Table 2. Analysis of the multiple regression between CAO and the parameters of the phenolic maturation of grapes

	Coefficients	Standard Error	t Stat	P-value
Intercept	-8069.8	11539.68	-0.699	0.5105
X ITP	31.46	6.52	4.829	0.0029
X AE	0.1	0.25	0.435	0.6791
X MP	8515.7	11550.60	0.737	0.4888
X MS	7618.4	11691.29	0.652	0.5388

The equation 1 can be used to estimate the antioxidant capacity of wines based on the values of the parameters characterizing the phenolic maturation of grapes at harvest, provided the maceration during winemaking is kept at 6 days at 28-30°C, as in the experimental conditions .

CONCLUSIONS

The antioxidant capacity of the wines belonging to the AOC Dealu Mare Valea Calugareasca old wine assortment and to the newly created one varied between 1181 and 2600 µM TE/100 ml.

The highest values of the antioxidant potential were registered in case of the 'Olivia', 'Negru aromat' and 'Novac' wines; 'Negru moale', 'Negru virtos', Blauerzweigelt', 'Burgund mare', 'Cabernet Sauvignon' and 'Merlot' wines were characterized by a low antioxidant capacity. 'Feteasca neagra' and 'Pinot noir' wines showed a medium antioxidant capacity.

There was a strong correlation between the antioxidant capacity of the wines and total amount of polyphenols, catechins and tannins.

The antioxidant capacity of the wines can be estimated based on the phenolic maturity indicators using the relationship CAO=8070+31ITP+0.10AE+8516MP+7618MS.

This classification is valid only for the winemaking processes in which the maceration on skins is performed for only 6 days at 28-30°C. For longer maceration periods the antioxidant capacities displayed by high tannic cultivars, such as 'Cabernet Sauvignon', 'Merlot' or even 'Pinot noir' and 'Feteasca neagra', may be significantly increased.

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