THE EFFECT OF DIFFERENT AMERICAN VINE ROOTSTOCKS ON THE PHYTOCHEMICAL CHARACTERISTICS IN DRIED BANAZI BLACK GRAPE (*VITIS VINIFERA* L.)

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(Received 6th Jul 2017; accepted 2nd Oct 2017)

Abstract. Banazi Black grape which is almost never consumed freshly is a very important, seed bearing, local type which is directly dried in the sun with its cluster without any processing. Ungrafted (5 years old and over 40 years old) and grafted (41B, 99R, 1103P and 110R) Banazi Black grape varieties which were 5 years old were used in the study conducted in Turkey, Malatya, Yesilyurt district, Konak town. The grapevines in the farmer vineyards, grown in dry conditions, were established in the form of blocks, serpene cultivation was applied on the stocks, and cane training was made. The photochemical characteristics of the dried grape belonging to the rootstocks used in 5 year-old Banazi Black grape which were ungrafted (5 and 40 years old ungrafted) and grafted with 41B, 99R, 1103P, 110R rootstocks were investigated in this study. It was determined from the analyzed phenolic compounds that gallic acid was 4.10-14.43 mg/kg; catechin was 146.87-306.87 mg/kg, rutin was 38.96-78.15 mg/kg, naringin was 22.54-50.97 mg/kg, phloridzin was 40.03-107.72 mg/kg, and quercetin was 0.47-1.67 mg/kg. Total antioxidant capacity in total phenolic substance rootstocks was determined to be 0.19-0.22 mg trolox equivalent/g; gallic acid/g was 7.51-21.66 mg. The amount of resveratrol was between 0.19-1.30 mg/kg among the rootstocks. The differences between the rootstocks were statistically significant in terms of phenolic compounds. 40 year-old ungrafted vinestock took a higher value when compared to the other rootstocks in terms of phenolic compounds.
Keywords: *dried grape, grafted-ungrafted, antioxidant content, phenolic content, Malatya*

Introduction

Turkey is an important vine cultivation center in the world. According to the data of TÜİK [Turkish Statistical Institute] (2016), 4,000,000 tones grapes, including 1,990,604 tones table, 1,536,269 tones dried, and 472,534 tones wine grapes, were grown totally in the 4,352,269 da. area in Turkey (Anonymous, 2017).

The farming of cultivated grapevine (*Vitis vinifera* L.) has been conducted in Turkey since 6000-5000 B.C. (Doğer, 2004). Grapevine is an important cultivated plant in Turkey as it is economical in terms of grape yield and a genetic material with its abundant varieties. (Celik, 1998; Celik et al., 1998). This abundance of the grapevine gene potential creates an important source for both the rehabilitation works and the production of the local types that have economic importance.

Grapevine has always kept its value among the agricultural products with its richness in terms of gene potential, its economic importance, and its significance in human nutrition and health. Generally, there are water, sugars, organic acids, phenol

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/1504_19011915

compounds, pectic substances, aroma substances, nitrogenous substances, enzymes, vitamins and minerals in the compound of grapes (Fidan and Yavas, 1986; Canbas, 2003; Jackson, 2003).

The species and varieties of grapevines are the foremost plant species that are rich in phenolic compounds (Lohachoompol et al., 2004). These compounds are synthesized structurally in all organs of the grapevine and their proportions in fruit and seeds are affected by environmental conditions (Ough and Amerine, 1988).

Phenolic components which are defined as the secondary metabolism products of the plants are the primary natural compounds standing out with their antioxidant characteristics in terms of human health. According to scientific studies, phenolic compounds have antiallergic, antiinflammatory, antidiabetic, antimicrobial, antipathogenic, antiviral and antithrombotic effect (Knekt et al.,1996; Le Marchand et al., 2000; MacDougall, 2002; Aras, 2006; Kafkas et al., 2006).

One of the distinguishing characters of the colorful (red, black) grapes is phenolic compounds. It has been determined in the researches that colorful types are richer than white types in terms of phenolic substances (Cemeroğlu, 2004).

Just as each grape variety has a different tendency in terms of soil and climate, their response to the American grape-vine rootstock on which they are grafted may be different. For this reason, the most appropriate chemical component a grape type can reach is directly related to the soil structure and climate of the territory it is cultivated in and the rootstock on which it is grafted (Amerine et al., 1972; Jackson, 2000; Ribéreau-Gayon, et al., 2000; Canbas, 2006; Kelebek, 2009; Rolle et al., 2010).

There are some studies on the influence of the local grape varieties in Turkey, the vineyards that they are cultivated in, and the climatic conditions on the phenolic compounds of the grapes, yet these studies are not enough. However, vine cultivation activities are distributed in different geographical regions in our country which have different climatic characteristics. The fact that these regions have different characteristics in terms of climatic and soil conditions will make a difference in terms of phenolic compounds which directly affect the quality factor of our local grape varieties. For this reason, new studies which will deal with our local grape varieties the regions in which they are cultivated are needed.

Banazi Black grape is cultivated throughout Malatya, but it has specifically adapted to Konak town (Banazi), Yesilyurt and Akcadağ districts which are located in 1000-1300 m above sea-level (Koc et al., 2015).

People prefer ungrafted cultivation, since they think grapes have a specific taste, flavor, and color. However, the fact that the vineyards in the region are limy and waterless led people to use rootstocks resistant to lime and aridness. The use of rootstocks is important because it provides earliness in Banazi Black grape (Koc et al., 2015).

It was determined in the studies that phenolic compound concentration varies by grape variety, the environment it is cultivated and environmental factors. This study aims to determine some photochemical characteristics of Banazi Black grape, which has adapted to Malatya Yesilyurt ecology and is cultivated with or without grafting, within the scope of the significance of rootstock-variety relationship in vine cultivation.

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/1504_19011915

Materials and methods

Material

Our study, the analyses of which were carried out in Malatya Apricot Research Institute research and application laboratories, was conducted in 2014 (38°16´53.31” N - 38°17´13.38” E, at 1290 m altitude) (*Figure 1*).

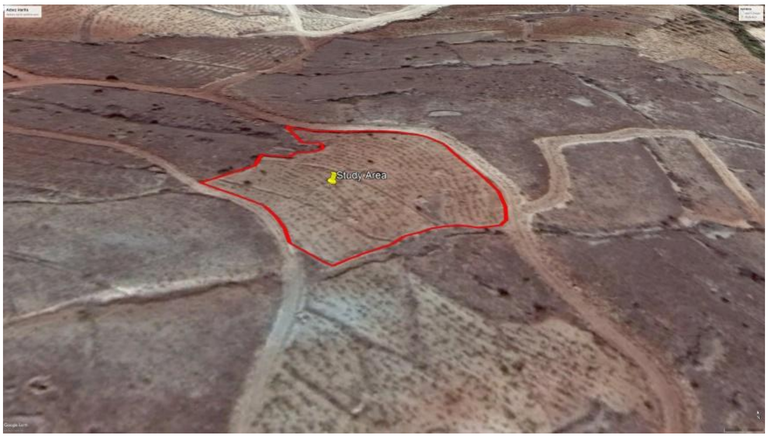

Figure 1. *The research center where the experiments were conducted*

The materials of the study are ungrafted 5 and 40-year old Banazi Black grape and 5 year-old Banazi Black grape variety grafted on 41B, 99R, 1103P, 110R American grape-vine rootstocks.

The study was conducted in the farmer vineyard, where serpene cultivation was applied on the stocks shaped like blocks in dry conditions with 2×2 distances and cane training was made, in the control of Malatya Apricot Research Institute personnel in Malatya Konak (Upper Banazi) area which is 1290 m above sea-level.

Banazi Black grape which ripens between September 10th and 20th is a seed bearing, local variety which is dried in clusters and put on market naturally. Grapes are blue-black, globular and moderate-sized. The fact that it is dried with its cluster provides a perceptual superiority for the consumer. The clusters are conical, medium (250 g-350 g) and dense (*Figure 2*).

Figure 2. *Fresh and dried Banazi Black grape fruit*

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
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It is not subjected to any chemical process during drying process. Harvest starts when the first withering appears on the grapes of the cluster on the stock. The clusters that are harvested are subjected to drying process either directly on the soil or on the cloths laid on the soil (*Figure 1*) Drying process lasts between 5-9 days (Koc et al., 2015).

Geographic position of the research location

Yesilyurt, which is one of the two central districts of Malatya with its surface area of 1013 km², is surrounded by Battalgazi on the east, Akcadağ and Doğansehir on the west, Celikhan and Adıyaman on the south, Yazıhan on the north. Yesilyurt district where the vineyard used in the test is located is on a transit area between Southeastern Anatolia Region terrestrial precipitation and Mediterranean Region marine precipitation, and between Eastern Anatolia Region terrestrial precipitation and Central Anatolia Region precipitation (Anonymous, 2015).

Soil characteristics of the research location

Earth sample taken from 0-30 cm depth in the vineyard was analyzed in Malatya Apricot Research Analysis Laboratory (*Table 1*).

Table 1. *Soil analysis values of the test field*

Saturation (%)	pH	Total salt (%)	Lime (%)	Organic matter (%)	EC (µS/cm)	P (kg/da)	K (kg/da)
51.70	7.75	0.0228	37.90	1.33	0.69	8.48	77.89

It can be seen on *Table 1* that since saturation value is 51.70, vineyard where the research was conducted has “Clay-Loam” soil. It can be seen that the test field is saltless with a value of 0.02%, is very limy with 37.90% lime ratio, has low organic substance with 1.33% ratio, and has an adequate structure with 8.48 kd/da phosphor and 77.89 kg/da potassium. It was determined that it had loose-alkali structure with 7.75 pH and its electrical conductivity EC (mS/cm) value was 0.690. As a consequence of the soil analysis 300-400 g sulfur and 15-20 kg burnt farm manure were applied on each stock during the early spring.

Climatic characteristics of the research location

Some important meteorological data belonging to Malatya-Yesilyurt district ecology where the research was conducted are given on *Table 2* and *Table 3* (Anonymous, 2015).

The ripening of the clusters belonging to the stocks coincided with September in which the average temperature was 22.7 °C during the time when the research was conducted in 2014. During the harvest season in this year total precipitation was 53.8 mm for September, monthly average relative humidity was 32.6%, and minimum temperature was 8.3 °C for September, 2014 (*Table 3*).

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/1504_19011915

Table 2. *Some climatic data belonging to the research location*

Months	Monthly minimum temperature (°C)				Monthly average temperature (°C)			
	2011	**2012**	**2013**	**2014**	**2011**	**2012**	**2013**	**2014**
January	-5.2	-10.0	-9.6	-4.3	2.4	0.6	0.9	4.1
February	-6.1	-10.0	-4.5	-7.2	3.1	-1.5	-	-
March	-1.7	-6.5	-3.9	-3.4	8.4	3.4	8.8	10.4
April	-0.9	3.6	5.7	1.4	12.2	14.9	14.9	15.4
May	6.6	-	9.5	9.9	17.0	-	19.5	19.6
June	12.9	11.0	12.6	12.4	23.5	25.6	24.5	23.9
July	16.6	13.9	16.1	19.0	29.0	28.7	27.2	30.3
August	15.1	16.4	-	18.8	28.0	28.3	-	30.8
September	13.2	13.8	11.2	8.3	23.1	-	21.8	22.7
October	4.5	8.3	4.0	3.7	14.9	16.6	14.5	15.3
November	-6.1	1.7	1.7	0.5	4.7	10.7	10.6	7.3
December	-4.5	-2.4	-	-0.4	1.7	3.5	-	6.4

*(-) No value was assigned by the Directorate of Meteorology
**(0.0) There is no precipitation. Monthly maximum temperature was not given by the Directorate of Meteorology

Table 3. *Some climatic data belonging to the research location*

Months	Monthly total precipitation (mm)				Monthly relative humidity (%)			
	2011	**2012**	**2013**	**2014**	**2011**	**2012**	**2013**	**2014**
January	23.3	39.0	62.4	29.4	66.4	-	-	-
February	63.3	51.0	52.2	28.5	-	-	-	-
March	18.4	22.8	20.1	40.2	46.1	51.3	50.5	48.0
April	95.8	27.1	39.6	50.1	60.2	-	45.7	44.9
May	42.9	-	773	36.0	53.1	-	46.2	40.5
June	10.0	15.5	10.8	18.3	35.8	28.3	26.7	28.8
July	5.5	1.5	0.0	0.0	26.9	23.6	23.2	19.7
August	8.4	0.2	-	0.7	25.9	24.7	-	19.5
September	5.2	0.0	17.1	53.8	29.3	-	29.6	32.6
October	6.2	58.0	12.9	92.2	39.9	-	34.0	56.4
November	40.8	64.6	25.1	56.0	-	-	-	-
December	42.8	84.9	-	31.6	67.4	-	-	-

*(-) No value was assigned by the Directorate of Meteorology
**(0.0) There is no precipitation. Monthly maximum temperature was not given by the Directorate of Meteorology

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Method

The test was planned to be in three repetitions with 6 stocks for each one in the vineyard where the research was conducted, which was shaped like blocks.

Sampling

Sample grape clusters for each stock and each of the three repetitions were taken when the first withering started on the clusters of the stocks (Koc et al., 2015), the color and taste specific to the variety formed and the dry matter amount reached to 23-24 Brix value, and these samples were left for drying on cloth shelves.

The grapes on the dried clusters belonging to the stock in each repetition were plucked and ground in blenders. These samples were put into glass jars to be analyzed later and kept in -20 °C.

Extraction of the phenolic components

2.5 g was taken from the Banazi Black grape sample which was dried, ground, and homogenized, and it was put into a falcon tube of 50 ml. 15 ml of methanol:water:HCI (70:29, 9:0.1) solvent mixture which was prepared previously was added on the sample and it was homogenized. The samples which were kept in dark for 12 h were centrifuged at 9000 rpm and transferred to a new supernatant falcon tube. 15 ml solvent mixture was added on the residue and it was mixed and centrifuged again. The supernate was added to the previous one. Extraction process was repeated for the third time. After about 45 ml of extract was obtained, the same extract was evaporated in a vacuum evaporator in inert environment until dryness. Rhe residue was dissolved with 3 ml methanol:water (50:50), syringed, filtered through 0.45 µm cellulosic filter, and the final filtrate was used in the determination of phenolic components, total phenolic substance amount and total antioxidant capacity (Milan et al., 2011).

Determination of phenolic components with HPLC

First, RT (retention time) in HPLC system and wavelength were determined for each of the 17 different phenolic standard compounds (*Table 4*). Then, mixture standard including all phenolic compounds was prepared and its calibration chart was drawn. Two different solvent mixtures were used as the mobile phase.

Mobile Phase A: Water: Acetic Acid (95.5%: 4.5%), Mobile Phase B: Acetonitrile

Table 4. *Gradient program applied on HPLC system*

Analysis time (mn)	Solvent (B)	Flow rate (ml/mn)	Temperature (°C)	Wavelength (λ)
0.01	0	1	30	280,290,355,310,329,370
7	5	1	30	280,290,355,310,329,370
12	15	1	30	280,290,355,310,329,370
20	40	1	30	280,290,355,310,329,370
25	100	1	30	280,290,355,310,329,370
30	100	1	30	280,290,355,310,329,370
40	5	1	30	280,290,355,310,329,370

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
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Determination of total phenolic substance amount

The content of total phenolic compound was determined according to Folin-Cicalteu spectrophotometric method developed by Slinkard and Singleton (1977) in the study. "Folin & Ciocaltue" method was used to determine total phenolic substance amount and total phenolic substance values were measured in terms of gallic acid. After 50 µl was taken from the extracts and 950 µl water was added on it, 1 ml of Folin-Ciocaltue solution was added and it was kept waiting for 3 min. After this period, 1 mL was made 3 mL with 2% Na_2CO_3 solution, it was kept waiting for 10 min, and reaction was balanced. Absorbances of the colored solutions were measured to be 760 nm in terms of wavelength.

Determination of total antioxidant capacity

Two tests, DPPH Radical Scavenging Power Test and TEAC (Trolox Equivalent Antioxidant Capacity) were carried out.

DPPH radical scavenging power test

Radical scavenging power (RSP) measurement was carried out according to formula 1 suggested by Yen et al. (2000). The samples which were prepared in 1.10-4 M DPPH ethanol were left for incubation at ambient temperature with extracts obtained from grape samples in 0.1 ml of different concentrations and 2.9 ml of DPPH solution that were put into in spectrophotometer tubs. During the control, ethanol was put instead of the sample. The absorbance of the tubes was read against 517 nm after 30 min of incubation. RSG values were calculated according to the following formula (*Eq. 1*).

$$\text{RSG} = [1 - \frac{A_{Ö:30}}{A_{K:30}}] \times 100 \tag{1}$$

$A_{Ö:30}$: For example, absorbance in the 30th min of $A_{K:30}$: Control

TEAC (Trolox Equivalent Antioxidant Capacity) test

7 mM ABTS (2,2-Azinobis 3-ethylbenzothiazoline 6-sulfonic acid) was mixed with 2.45 mM potassium bisulfate and it was kept waiting in a dark environment for about 12-16 h. This solution was purified with 0.700±0.01 absorbance in 734 nm wavelength with sodium acetate (pH 4.5) buffer in spectrophotometer, 2.98 mL of the solution was blended in 20 µL fruit extract, and the absorbance was measured in 734 nm wavelength in spectrophotometer ten minutes later. The obtained absorbance values were calculated with Trolox (10-100 µmol/L) standard slope chart and it was stated as µmol Trolox equivalent/g fruit (Özgen et al. 2006).

Statistical analysis

SPSS packaged software was used in determining the influence of rootstocks on photochemical characteristics and the differences between the averages were stated with Duncan multiple comparison test. 3 repetitions and the averages of 10 clusters taken from 6 vinestocks in each repetition were used for the characteristics measured in the study. Statistical materiality level was considered as $P < 0.05$.

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
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Results

Findings concerning the change of phenolic components

Quercetin, catechin, gallic acid, rutin, naringin and phloridzin dehydrate in Banazi black were found to be in identifiable levels. As can be seen in *Table 5,* the examined phenolic compounds were statistically significant in comparison with the rootstocks. Average gallic acid was determined to be at the lowest amount in 99R rootstock (4.10 mg/kg) and at the highest amount in 40-year old ungrafted vinestock (14.43 mg/kg). Catechin was at the lowest amount in 110R rootstock (146.87 mg/kg) and at the highest amount in 40 year-old ungrafted vinestock (306.87 mg/kg). Rutin was at the lowest amount in 99R rootstock and at the highest amount in 40-year old ungrafted vinestock (38.96-78.15 mg/kg). Naringin was determined in ungrafted young and 40 year-old vinestocks with 22.54-50.97 mg/kg, Phloridzin was in 99R and 40 year-old ungrafted vinestocks with 40.03-107.72 mg/kg, and Quercetin was in 110R and 40 year-old ungrafted vinestocks with 0.47-1.67 mg/kg.

Table 5. *Some phenolic compounds in detectable levels in the study*

Rootstocks	**Gallic acid mg/kg dry**	**Cateşin mg/kg dry**	**Rutin mg/kg dry**	**Naringin mg/kg dry**	**Phloridzin mg/kg dry**	**Quercetin mg/kg dry**
Ungrafted (young)	5.164bc	212.60b	75.44ab	22.54b	50.22c	0.65c
Ungrafted (old)	14.43a	306.87a	78.15a	50.97a	107.72a	1.67a
1103P	8.939b	187.54bc	75.48ab	35.91b	79.43b	1.51a
110R	5.304bc	146.87c	53.75c	32.68b	51.45c	0.47c
99R	4.107c	184.44bc	38.96d	29.93b	40.03d	1.08b
41B	6.697b	173.23bc	67.78b	34.01b	75.56b	1.04b
Significance	0.592	0.001	0.008	0.000	0.001	0.021

$^{*}P < 0.05$ level of significance. Different letters show that the difference between the averages is significant according to Duncan test

Taking the average values into consideration, 99R and 110R rootstocks, known to be late season variety, were at lower levels when compared to the other rootstocks in terms of the determined phenolic compounds. The values of the clusters obtained from 40 year-old ungrafted vinestocks were recorded to be higher than the other rootstocks' values.

Total antioxidant capacity (TAC)

There was no statistically important difference among the rootstocks in terms of free radical (DPPH) removal activity in determining total antioxidant capacity (TAC) in the study. TAC values were determined to be 0.19-0.22 mg /g between the rootstocks (*Table 6*).

It can be seen from *Table 6* that there were statistically significant between the rootstocks in determining TEAC (trolox equivalent antioxidant capacity). While the lowest average value was obtained from 99R rootstock, the highest value was determined to be in the clusters obtained from 40 year-old ungrafted vinestocks (0.17-0.70 mg/g). The values in other rootstocks were young ungrafted vinestock 0.18 mg/g, 1103P 0.59 mg/g, 110R 0.49 mg/g, 41B 0.50 mg/g.

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/1504_19011915

Table 6. *Resveratrol, total antioxidant capacity and phenolic substance amount*

Rootstocks	Total antioxidant capacity (mg trolox equivalent /g antioxidant capacity)		Total fenolik (mg gallik asit/g dry)	Resveratrol (mg/kg dry)
	DPPH	ABTS		
Ungrafted (young)	0.19b	0.18c	11.60bc	1.30a
Ungrafted (old)	0.20ab	0.70a	21.37a	0.32b
1103P	0.21a	0.59ab	14.73b	0.49b
110R	0.20ab	0.49b	17.08ab	0.71ab
99R	0.22a	0.17c	7.51c	0.49b
41B	0.19b	0.50b	21.66a	0.19b
Significance	0.255	0.017	0.159	0.021

*$P < 0.05$ level of significance. Different letters show that the difference between the averages is significant according to Duncan test

Bozan et al. (2008) revealed in their study, in which they investigated the antiradical effects of different grape varieties growing in our country, that different grape varieties removed DPPH radical in different proportions with the effect of their different phenolic contents.

Total phenolic substance amount (TPSA)

Average total phenolic substance amount (TPSA) in dried Banazi Black grape variety changed between 7.51-21.66 mg gallic acid/g. The differences between the rootstocks in terms of TPSA were considered statistically significant in our study. The lowest value was obtained from 99R rootstock and the highest value was obtained from 41B rootstock and 40 year-old ungrafted vinestocks (21.66-21.37 mg gallic acid/g). TPSA in the clusters obtained from the other rootstocks was 110R 17.08 mg/g, 1103P 14.73 mg gallic acid/g and TPSA in ungrafted young vinestock was 11.60 mg gallic acid/g.

Özden and Vardin (2009) determined in their study that Chardonnay (3170 mg/kg) variety had high phenolic substance amount, followed by 2376 mg/kg Merlot 9 variety, and total phenolic contents of Cabernet sauvignon and Syrah varieties were 1968 and 1805 mg/kg, respectively.

Alphonse Lavallèe and Horoz Black grape varieties were determined to be the ones with the highest production of total phenolic substances, 3.084 and 2.832 mg/g, respectively (Cetin, 2012).

In the study on ripe grapes belonging to 12 wine grape varieties, Singleton (1966) determined that total phenolic compound amount in terms of gallic acid was 3770 mg/kg as an average value (when it is converted into the unit in our study, the result is 3.77 mg/g). The researcher also determined that phenolic compound amounts were different according to species and varieties.

Resveratrol

It was determined as a result of the analyses that Banazi Black grape contained the phenolic compound named in many studies as resveratrol, which has antioxidant, antimutagenic, antiinflammatory, anticarcinogenetic and chemoprotective effects.

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
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Resveratrol amount changed in 0.19-1.30 mg/kg between the rootstocks. The lowest average value was determined in the grapes obtained from 41B rootstock and the highest value was determined in the grapes obtained from young ungrafted vinestocks. For 40 year-old ungrafted ones, it was determined to be 0.32 mg/kg, 1103P 0.49 mg/kg, 110R 0.71 mg/kg and 99R 0.49 mg/kg (*Table 6*).

The flavonoid contents of 500 µl fruit extract of Banazi Black are 1523.07 µg catechin, 591.79 µg rutin and 1.6661 µg resveratrol (Özşahin, 2010).

Discussion

In this study, the changes of young-old and rootstock-variety performances in the levels of phenolic compounds, total antioxidant capacity (TAC), total phenolic substance amount (TPSA) and resveratrol after Banazi Black grape variety, which has an important position in Malatya as seed-bearing grape for drying with its gene potential, was grown on different rootstocks in its original ecology were investigated within the scope of the importance of rootstock-variety relationship in vine cultivation practices.

Because common and interconverted units are not used to evaluate phenolic compound results in literature studies, the comparison and discussion of the results have become a problem. For this reason, the obtained values were compared to the studies using similar or interconvertible units (mg/kg, mg/100g, mg/g, g/kg etc.).

The differences among the rootstocks in terms of TPMS amount were considered statistically significant in our study. According to the averages, the lowest value was obtained from Banazi Black grape grafted on 99R rootstock, the highest value was obtained from Banazi Black grape grafted on 41B rootstock and 40 year-old ungrafted vinestock (21.66-21.37 mg gallic acid/g). Taking the worldwide known wine grape varieties such as Cabernet sauvignon (1968 mg/kg), Merlot (2376 mgkg), Syrah (1805 mg/kg) and edible variety Alphonse Lavallée (3466 mg/kg) into consideration (Singleton, 1966; Núñez et al., 2004; Özden and Vardin, 2009; Kelebek, 2009) 7.51-21.66 mg gallic acid/g values (when the units were converted, Cabernet sauvignon 1.968 mg/g, Merlot 2.376 mg/g, Syrah 1.805 mg/g, Alphonse Lavallée 3.466 mg/g) obtained in our study were over these limits.

Aras (2006) determined that TPSA content changed between 2.88-3.42 mg/g for red grapes and 1.87-2.22 mg/g for white varieties. Karakaya et al. (2001) reported that total phenolic substance amount was 3.99 mg/g for dried grapes and 2.21 mg/g for red grapes. When these data are compared to the ones in our study, we can say that Banazi Black grape contains a very high amount of TPSA.

According to studies, while TPSA concentrations of black grapes are 1800 mg/kg on average, this value is 405 mg/kg for white varieties (Frankel et al., 1995; Shahidi and Naczk, 1995).

Cultivation conditions, rootstocks that are used, grape variety, and extraction and analytical methods that are used are considered to have an effect on the values found by the researchers.

Free radical (DPPH) removal activity was determined to be 0.19-0.22 mg/g (41B and 99R) in determining total antioxidant capacity (TAC) in the study. There was no statistically important difference among the rootstocks.

The differences among the rootstocks were considered statistically significant in determining TEAC (trolox equivalent antioxidant capacity). In terms of the averages,

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DOI: http://dx.doi.org/10.15666/aeer/1504_19011915

the lowest value was obtained from Banazi Black grape grafted on 99R rootstock and the highest value was in ungrafted old vinestock (0.17-0.70 mg/g).

Banazi group in the samples of 25µl concentrations had radical cleaning effect in a very significant proportion when compared to the other samples in a study comparing free radical cleaning activities of the grape extracts (Özsahin, 2010).

When Bozan et al. (2008) investigated the antiradical effects of different grape varieties cultivated in our country, they revealed that different grape varieties removed DPPH radical in different proportions because of their different phenolic contents.

According to a study, while CAT (catalase antioxidant enzyme) activities of Sultani seedless grape variety grafted on 1103P, 110R and 41B rootstocks in low salt concentration increased, CAT activities of Sultani seedless grape variety grafted on 1616C and 1103P rootstocks in high salt concentration increased. SOD (super oxide dismutase) activities of Sultani seedless grape variety grafted on 1103P, 110R and 99R rootstocks in high salt application increased. On the contrary, SOD activities of Sultani seedless grape variety grafted on 140Ru and 41 B rootstocks decreased. In low salt application SOD activity on 1616C 140Ru, 110R and 41B rootstocks decreased. According to the control, AP (ascorbate peroxidase) activities of Sultani seedless grape variety grafted on 110R, 99R and 41B rootstocks in low salt application increased while AP activities of 1616C and 140Ru rootstocks decreased. AP activity of Sultani seedless grape variety grafted on 110R rootstock in high salt application increased (Sahin, 2009).

This study on Sultani seedless grape grafted on different rootstocks show that the effect of rootstocks on antioxidative enzyme activities is significant. According to our study, the statistical differences in TEAC determination on six rootstocks belonging to a single variety resulted from the rootstocks.

Quercetin, catechin, gallic acid, rutin, naringin and phloridzin dihydrate were found in detectable levels in the extracts of dried Banazi Black grape in our study. Gallic acid was determined to be at the lowest amount in Banazi Black grape grafted on 99R rootstock (4.10 mg/kg) and at the highest amount in ungrafted old vinestock (14.43 mg/kg). Catechin was at the lowest amount in Banazi Black grape grafted on 110R rootstock (146.87 mg/kg) and at the highest amount in ungrafted old vinestock (306.87 mg/kg). Rutin was at the lowest amount in Banazi Black grape grafted on 99R rootstock and at the highest amount in ungrafted old vinestock (38.96-78.15 mg/kg). Naringin was determined in ungrafted young and old vinestocks with 22.54-50.97 mg/kg, Phloridzin was in Banazi Black grape grafted on 99R and ungrafted old vinetocks with 40.03-107.72 mg/kg, and Quercetin was in Banazi Black grape grafted on 110R and ungrafted old vinestocks with 0.47-1.67 mg/kg. According to a study, the amount of total phenols increase with the ripening of leaves; old leaves on the same vinestock contain more phenolic compounds than young leaves (Medeghini et al., 1992). According to our study, the phenolic compound amount obtained from ungrafted old vinestocks is higher than the phenolic compound amount obtained from Banazi Black vinestocks produced as young grafted and ungrafted vinestocks.

The differences among the detected phenolic compounds were considered statistically significant in the rootstocks. Taking these values into consideration, it is considered that the rootstocks used in our study are effective on phenolic compound amount.

In another study done by Aydınlık (2012), phenolic substance analyses of the grape molasses (pekmez) samples produced in Niğde were conducted with the method of HPLC. It was found out that grape molasses (pekmez) samples contained gallic acid,

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catechin, caffeic acid, epicatechin, p-coumaric acid and ferulic acid and their concentrations were 47.94±2.58, 148.69±11.17, 20.7±2.08, 101.25±5.8, 12.24±1.65 and 18.26±2.58 mg/kg, respectively.

Resveratrol amount changed between grafted and ungrafted rootstocks in 0.19-1.30 mg/kg. the lowest value was obtained from Banazi Black grape grafted on 41B rootstock and the highest value was obtained from the young vinestock without rootstocks.

Flavonoid and resveratrol contents of Banazi Black grape extracts were determined to be 1980.00±2.88 mg/g for catechin, 769.33±2.33 mg/g for rutin, 2.16±0.16 mg/g for resveratrol (Özsahin, 2010). These values show that Banazi Black grape has a rich phenolic substance source in harmony with our study.

Bartolomeo (1996) and Zhao (1999) reported that the fundamental phenolic content of the grape consisted of resveratrol, catechin ve epicatechin. In addition, the studies showed that grape was a rich phenolic compound source and 46-69% of these phenolic compounds was in the seed, 12-50% was in the skin, 8% or less was in the pulp.

Phenolic substance amount of the grapes change depending on the variety, ripeness, environmental conditions such as climate and soil and applied cultural processes (Ribéreau-Gayon et al., 2000). However, the quality and quantity of phenolic compounds of grapes depend on grape variety. While the existence of certain phenolic substances and the proportions of their amounts to each other depend on the characteristics of species and varieties genetically controlled, total phenolic substance amount or the sort of phenols in the compound depend on environmental factors (Singleton and Esau, 1969).

The content of phenolic compounds changes based on the soil conditions in which the vinestock is cultivated and cultural applications. The soils with high sodium content and pH reduce phenolic substance amount in the seed, peel and stem (Quintana and Gomez, 1989), and irrigation applications increase total phenol amount in leaves and offshoots (Madero et al., 1978). Besides, the form of cultivation, rootstock and herbicide applications affect the content of phenolic substances in the vinestock and grape (Bezhanishvili et al., 1982; Smart and Smith, 1988). In line with our study, these studies conducted by other researchers show that rootstocks are effective in terms of phenolic compound contents.

In addition to the reasons reported in the previous studies, the difference in the values of our study may result from the fact that dried Banazi Black grape is ground and analyzed with its peel, pulp and seed and from the rootstocks that are used. As a matter of fact, according to a study, the 38% of the total phenol content of red and white grape varieties is seeds, 36% is peel, 20% is stem and 6% is pulp (Flanzy et al., 1972).

The researchers who determined that pure and hybrid rootstocks used in modern vine cultivation has different effects based on the content of grape juice, wine quality and coloration (Ruhl, 1991; Bisson, 1992; Kaserer and Schofll, 1994) reported that sugars, amino acids, pH and K level in the content of anthocyanin, acidity and grape peel color changed with grafting, and acidity increased excessively with the increase in productivity and affected wine quality.

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
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Conclusion

One of the oldest forms of conserving fruits and vegetables is drying, its importance still continues. Drying grapes for preserving is the easiest and most economical way of conservation that has been implemented for years (Dokuzoğuz, 1972).

Because both edible grapes and various products produced from them are rich in phenolic compounds and they have bioactive characteristics for human health, grape, especially black grape, is a food product that must be a part of our nutrition.

When the data in this study is taken into consideration, the fact that grafting is effective on Banazi Black grape type produced with or without grafting, with regard to Resveratrol, Total Phenolic Substance amount, Total Antioxidant Capacity and some Phenolic Compounds, becomes more important. The obtained results are expected to provide an insight into the studies that will be conducted in future, since the current study is the first study conducted on dried grape of "Banazı".

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