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Research Article

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Total Phenol and Antioxidant Activity of Kabarcık' Grape (*Vitis vinifera* L.) Variety

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Abstract The aim of this study was to detect total phenol and antioxidant activity of various parts such as pulp, skin and seeds of 'Kabarcık' grape variety grown in Kahramanmaras provinces of Turkey. Total phenolic content of the samples were determined by the Folin Ciocalteu method by Spectrophotometer. Total antioxidant activitiy of samples were evaluated using the 1, 1-diphenyl-2- picrylhydrazyl (DPPH.) radical scavenging method. Total phenolic contents varied from 184.39to 213.71 mg GAE g^{-1} in pulp; 229.57 to 297.72 mg GAE g^{-1} in skin and 207.05 to 246.25 mg GAE g^{-1} in seed extracts. Radical scavenging activities of the samples changed depending on the different parts of pulp, skin and seed types. The highest antioxidant values were observed in skin and the lowest were in pulp samples. The highest total phenol amount was recorded in seed and the lowest values were in pulp samples. The results suggest at phytochemicals in 'Kabarcık' grape variety has potent antioxidant activities.

Keywords grape, antioxidant, total phenol, *Vitis vinifera*

Introduction

Grapes are grown in various parts of the world and are used such as fresh, dried or fruit processing industry. Grapes are a non-climacteric fruit that grows on the perennial and decideous woody vines and can be used as raw or edible or jam, fruit juice, jelly, vinegar, wine, grape seed extracts, raisins, grape seed and grape seed oil. Moreover, the grapes in Turkey, the traditional food processing industry such as pekmez (syrup), fruit juice, sucuk and bastık [1,2]. Grapes are among the most important fruits both in the world and in Turkey4 million tons and 462 thousands ha area, respectively [3].

In recent years, grapes have become increasingly popular as an important source of antioxidants such as phenolic compounds, polyphenols, anthocyanins, and the importance of these phenolic compounds is increasing day by day [4,5]. Thousands of phenolic compounds with different properties, quantities and functions have been identified in grapes [6-10]. Phenolic compounds are compounds having at least one aromatic ring and at least one hydroxyl group attached to this ring [6,11]. They are known to be the most important components of quality, as they are responsible for color, taste and aroma for grapes and have supportive effects on nutrition and health [4,12,13]. Phenolic compounds in grape and grape juice; nonflavlanoidal compounds such as flavonoids, especially flavan-3-ols (catechins and procyanidins), anthocyanins and flavonols, as well as hydroxycinnamic acids, hydroxybenzoic acids [4,14-16]. Grape (*Vitis vinifera* L.) is among the fruits with the highest content of phenolic compounds. Therefore, phenolic compounds of grape-by-products suc as skin and seeds have attracted much attention due to their antioxidant and antimicrobial properties and their potentially beneficial effects on human health [17,18]. The protective health effects of grapes are linked to phenolic contents. It is known that the presence of biochemical substances in grape composition and the ratio between them are genetically controlled species and varieties, while the amount in the content is shaped depending on the climate and soil effect, maturity stage and cultural practices in the field of cultivation and the compounds vary greatly [19-22].

On the other hand, in our country which has different climatic characteristics, viticulture activities are distributed to different geographical regions. The fact that these regions have different characteristics in terms of climate and soil conditions also constitute important differences in terms of biochemical compounds that directly affect the quality elements of our grape varieties.

In previıous years, various studies are investigated in the world to determine the phenolic compounds and antioxidant activities of different grape varieties [5, 16, 23-29]. However, the Turkey has a great bio-diversity in gpare variety, especially in Kahramanmaras province (located in the Eastern Mediterranean Region Anatolia of Turkey) and limited studies are conducted of researches on total phenolic and antioxidant contents of the 'Kabarcık' cultivar of the grown in this region. Thus, The objectives of this study was to determine the total phenolic content and antioxidant activities of different tissues such as grape seed, skin and pulp from 'Kabarcık' grape cultivar.

2. Material and Methods

2.1. Material

The city of Kahramanmaraşis located between 37° 43′ north longitude and 37° 8′ east latitude and at an altitude of 900 m and above sea level. It has a continental climate, with the highest average temperature in August (35.9ºC) and the lowest average temperature in January (1.2 ºC). TAGEM (General Directorate of Agricultural Research and Policy) and the grape varieties in the project called clonal selection projects was obtained from the parcel. Among the grape cultivars [30] that have been evaluated, cv. Kabarcık has medium sized grapes white-yellow in color and 1-3 seeds in each grape. Its clusters have conical-cylindrical structure, and it is the medium-sized and plump, mid-season cultivar.

Commercially ripen stages of grape fruit samples were harvested from Research and Experimental implementation area of K. Maraş provinces of Mediterranean region of Turkey in September, 2018. The fruits were sampled as seeds, pulp and fruit skin. Harvesting were done 5-day intervals in different periods when the commercially ripen stage (Table 1). Triplicate analysis were done using randomly selected experimental samples and each replicate 75 berry selected.

Table 1: Berry sampling dates of 'Kabarcık' cultivar

Cultivar name	Periods	Time (day/month/year)
'Kabarcık'	Fist Period	20.08.2018
	Second Period	25.08.2018
	Third Period	30.08.2018
	Fourth Period	05.08.2018
	Fifth Period	10.09.2018
	Sixth Period	15.09.2018

2.2. Total Phenolic Content Analysis

Total phenolic content of grape samples were done by modifying spectrophotometric Folin-Ciocalteu's method developed by Spanos and Wrolstad [31] and 10 ml of methanolic extract for 1 g homogenized grape samples were used. Obtained values expressed as mg gallic acid equivalent in 100 g extract (mgGAE/100 g).

2.3. Total Antioxidant Capacity

The antioxidant capacity was determined by the DPPH (2,2-diphenyl-1-picrylhydrazyl) radical-scavenging method according to the method of Brand-Williams [32] with some modifications (Duarte-Almeida et al., 2006). A 50 µL aliquot of the extract previously diluted and 250 µL of DPPH (0.5 mM) were mixed and after 20 minutes the absorbance was measured at 517 nm using a Microplate Spectrophotometer (Benchmark Plus, BioRad, Hercules, CA). The control consisted of a methanolic solution of Trolox (6-hydroxy-2.5.7.8-tetramethylchroman-2-carboxylic acid) at different concentrations. The antioxidant capacity was expressed as µmoles Trolox equivalents that g^{-1} sample in fresh weight (FW).

2.4. Statistical Analysis

The experiments were designed as a randomized complete block with three including three tree for each replicate. Statistical analysis was performed using statistical software from SAS (Version 7). Differences among the mean values were detected by the least significant differences (LSD) test at p=0.05.

3. Results and Discussion

Determination and extractive efficiency of phenolic compounds from plant material is greatly depended on the solvent. A large variation in total phenols and antioxidant capacity (AC) was found in the different tissue evaluated in the present study. Total phenolic content and antioxidant capacity of 'Kabarcık' grape cultivar were detected (Table 2). It was found that the total phenolic content (TPC) contents were significantly significance in different tissue samples taken at different periods ($P < 0.05$). According to the research results, TPC values ranged between 184.39 to 213.71 mgGAE/100 g in pulp, 229.57 to 297.72 in fruit skin and 207.05 to 246.25 mgGAE/100 gin seeds (Table 2). It was determined that the total phenol content was high especially during the first harvest periods and then decreased during the harvest period. Baydar et al (2010) also reported that total phenolic content the different cultivars were found as 522.49 mg GAE g^{-1} in seed and 41.98 mg GAE g^{-1} in skin (*Cabernet Sauvignon*) 546.50 mg GAE g^{-1} and 22.73 mg GAE g^{-1} (Narince). Total phenolic contents of seed extracts were lower than those of seeds as reported before by Baydar et al. [5] but seed and skin extracts were higher than as reported by Orak, [16] and Söylemezoğlu et al. [29]. Data obtained from the present study were similar to the findings of Karasu et al. [33]. The results show that the phenolic content of the skin and seeds was higher than that of the pulp that the present study were similar to the findings of Karasu et al. [33]. Breksa et al. [34] investigated the phenolic different grape cultivars and total phenolic content of these genotypes which were highly correlated with antioxidant capacities varied from 316.3 to 1141.3 to 269 mg gallic acid $100g^{-1}$equivalent.This variety contains more phenolic substances in their seeds and skins and it is advisable to consume seeds with varieties because of their potential health benefits (Table 2). The data obtained from the present study are in accordance with other previous studies [33, 35].

Table 2: Total Phenolic Compound Content and Antioxidant Capacity at different stages of berry maturation of grape fruits

		Berry sampling dates							
Parameters	**Part**	**First**	**Second**	**Third**	**Fourth**	**Fifth**	**Sixth**	**Period Average**	**D %5$_{Dönem}$**
Total phenolic (mgGAE/100 g**)**	Pulp	213.71±0.73^{a}	194.90±0.99^{d}	184.39±0.97^{e}	197.66±1.19^{c}	199.92±0.97^{b}	195.26±0.83^{d}	**197.64**	**1.69****
	Skin	235.07±0.94^{d}	238.14±0.89^{c}	297.72±0.57^{a}	229.57±0.93^{e}	248.07±0.96^{b}	235.87±0.56^{d}	**247.41**	**1.46****
	Seed	243.40±0.61^{b}	246.25±0.91^{a}	234.14±0.94^{d}	225.49±0.31^{c}	210.09±0.68^{e}	207.05±0.22^{f}	**227.74**	**1.17****
DPPH (%)	Pulp	209.73±1.35^{e}	293.84±0.24^{c}	319.28±0.42^{b}	522.36±0.49^{a}	152.27±0.87^{f}	213.25±0.74^{d}	**285.12**	**1.35****
	Skin	795.53±0.63^{d}	903.29±0.56^{c}	1236.46±0.59^{a}	1117.28±0.45^{b}	763.32±0.77^{e}	624.71±0.38^{f}	**906.76**	**1.02****
	Seed	285.35±2.20^{e}	304.55±0.55^{d}	500.91±0.88^{b}	553.43±0.80^{a}	363.72±0.47^{c}	223.16±1.11^{f}	**371.85**	**2.05****

*Data are the average of three replicates ± standard deviation; values are expressed as mgGAE/100 g and % DPPH; skin, pulp and seed; different letters above means indicate statistically significant differences 'Kabarcık' variety, *, **: Significant at $P < 0.05$, $P < 0.01$, respectively, by LSD test

Radical scavenging activities of grape extracts were tested by DPPH method and significant differences were found between genotypes and samples ($P < 0.05$). AC values ranged from 152.27% to 522.36%, 763.32% to 1236.46%, and 223.16% to 553.43% for pulp, skin, and seeds respectively (Table 2). AC of the grapes differed significantly depending on the 'Kabarcık' variety in a manner similar to TPC. The results show that the antioxidant activity in the seeds and skin is higher than the pulp. Although samples that had higher amounts of phenolics in the seeds and the skin showed higher antioxidant activity, therefore A positive trend between the antioxidant activity and the total phenolic content in the grape pulps and seeds was observed (Table 2).Some authors (reported a positive correlation between phenolic content and antioxidant activity in grapes while others [33, 36, 37]. Changes of antioxidant capacity different grape cultivars were similar to those reported by Bakkalbası et al., [38] Baydar et al. [5] and Karasu et al. [33]. Karasu et al. [33] also reported that antioxidant activity (DPPH) the different cultivars were found to 93.62% , 5.02%, 90.03% and 93.62 (Muskule); 5.92%, 92.20% and 95.80 % (Efes) pulp, skin and seed, respectively. Total antioxidant activity of our results were higher than those of different tissue as reported before by Karasu et al. [33]. For Wang et al. [39], DPPH radicals have a different stereochemical structure and a different genetic method and thus give a qualitatively different response to the inactivation of their radicals after reacting with the antioxidants. The antioxidant activities obtained from this study were higher than the other different cultivars studies [5, 28, 34, 40, 41, 42].

Conclusions

This study was the first comprehensive study to determine the phenolic content and antioxidant activities in 'Kabarcık' grapes cultivars of grown in Kahramanmaras ecological conditions. As a result, in this study showed that large differences were found among the different harvest period and grape parts in relation to the phenolics composition and antioxidant activities. The obtained results indicate that total phenolic contents, antioxidant activities and reducing powers of grape seed and skin extracts are higher than those of pulp extracts. According to the results, it can be said that there is a positive relationship between phenolic contents and antioxidant activities of the samples. According to the results of this study, it can be said that the 'Kabarcık' variety of grape different extracts can be used as an easily accessible natural antioxidant source. In addition, grape skin is a good foodstuff and can be used as a good nutritional supplement as a good source of antioxidants.

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