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DETERMINATION OF ANTIOXIDANT ACTIVITY, PHENOLIC COMPOUNDS AND BIOCHEMICAL PROPERTIES OF CHERRY LAUREL (*Laurocerasus officinalis* R.) GROWN IN SAKARYA/TURKEY

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ÖZ

Bu çalışma Sakarya ili merkez ilçe ve bağlı köylerinde yürütülen seleksiyon çalışmalarında selekte edilen karayemiş genotiplerinin bazı önemli biyokimyasal özellikleri ile birlikte fenolik içerikleri ve antioksidan aktivitelerinin belirlenmesi amacıyla yapılmıştır. Çalışmada, iki yıl boyunca elde edilen verilere göre seçilen 15 genotip incelenmiştir. İncelenen genotiplerde meyve salkım ağırlığı 21.60–109.27 g, salkımda meyve sayısı ise 19.00–27.00 arasında değişmiştir. Ortalama meyve ağırlığı 1.08–5.33 gr, meyve boyu 12.09–20.95 mm, meyve eni 10.58–21.94 mm, arasında değişim göstermiştir. Kuru madde miktarı %16.62–25.49, Titre edilebilir serbest asitlik (TESA) 0.22–0.49 arasında değişirken; meyve suyu pH'sı 4.43–4.93, azot içeriği %0.11–0.37, ham protein içeriği %0.67–2.31, suda çözünebilir kuru madde miktarı %15.53–31.36, kırılma indisi 1.356–1.385 ve kül içeriği %0.237–0.720, arasında değişim göstermiştir. Toplam fenolik madde miktarı 11.97–47.41 mg GAE/g dw ve antioksidan aktivitesi %3.36–25.10 arasında değişmiştir. Elde edilen sonuçlar ülkemizde yapılan çalışma sonuçları ve uluslararası verilerle karşılaştırıldığında bölgede yetişen karayemiş genotiplerinin incelenen özellikler açısından ümitvar bir potansiyel oluşturduğu ve farklı amaçlara göre, kontrollü şartlarda seleksiyon çalışmalarının devam ettirilmesi gerektiği kanısına varılmıştır.

Anahtar Kelimeler: Karayemiş, biyokimyasal, fenolik, antioksidan

ABSTRACT

This study was carried out in order to determine some biochemical characteristics, phenolic compounds and antioxidant activity in fruits of cherry laurel genotypes (*Laurocerasus officinalis* R.) grown in Sakarya province of Turkey. In this study, previously selected fifteen promising genotypes were examined. The cluster weight was changed between 21.60–109.27 g and fruit numbers of per cluster 19.00–27.00. The average fruit weight ranged from 1.08 to 5.33 g, fruit length ranged from 12.09 to 20.95 mm and fruit width ranged from 10.58 mm to 21.94 mm among the studied genotypes, respectively. Fruit dry matter contents were changed between 16.62–25–49%, titratable acid content (TAc) 0.22–0.49%; fruit juice pH value 4.43–4.93; nitrogen content 0.11–0.37%, crude protein content 0.67–2.31%, soluble solid contents (SSC) 15.53–31.36%, refractive index 1.356–1.385 and ash contents 0.237–0.720%, respectively. Total phenolic content was found between 11.97–47.41 mg GAE/g dry weight basis and antioxidant activity 3.36–25.10% among the genotypes. The results obtained suggest that genotypes searched have promising potential both for production and human health.

Keywords: Cherry laurel, *Laurocerasus officinalis*, biochemical, phenolics, antioxidants

INTRODUCTION

Turkey is the place of origin, domestication and micro gene centers for lots of fruit species including temperate zone fruit species. The country has three floristic regions, three main ecosystems and seven different climatic regions. Anatolia is also very rich for fruit species diversity [6]. One of these species is cherry laurel (*Laurocerasus officinalis* R.) [9, 16, 20, 29]. Cherry laurel originated in central and west Asia, southeastern Europe and

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Anatolia. In Turkey, cherry laurel is grown as a native fruit crop in the eastern Black Sea Region, Marmara and Aegean regions [30, 33]. The local name of this species is 'Taflan' and 'Karayemiş' [31]. It is mostly consumed as fresh fruit in local markets. Also, it has been used as dried, pickled and processed into molasses, jam, marmalade and fruit juice products. Besides its use for food, both fruit and seed of cherry laurel have been used for the treatment of stomach ulcer, digestive system complaints, bronchitis, eczemas and hemorrhoids for many years and as a diuretic agent are well known as traditional medicine in Turkey [3, 8, 17].

Phenolic compounds can be found in fruit, vegetables, seeds, flowers, leaves, branches and stems of plants. The compound of polyphenols from different kinds of vegetables and fruits differ considerably. Location of growth, temperature change between day and night, ultra–violet irradiation, sun light exposure and post–harvest treatment have been demonstrated to affect accumulation and stability of phenolic compounds in foods [4, 14, 15]. Phenolic compounds prove anti–aging properties attributed to their antioxidant activity by scavenging free radicals. In addition, they strongly affect the color and aroma of foods. Studies show that polyphenols in the diet affect the treatment of cardiovascular disease, diabetes, cancer and heart attacks [13, 28]. It was reported that most of the wild–harvested edible fruits have been contained higher amounts of nutrient and bioactive compounds compared to cultivated varieties [7, 27, 33].

Only few reports have been published on the bioactive contents of cherry laurel genotypes sampled in the West Black Sea Region. However, reports from the area of the diversity center, namely the Western Black Sea Region, are not available. Therefore, the aim of this study was to determine the characteristic physical and chemical parameters and phenolic compounds and antioxidant activity of a number of cherry laurel genotypes growing in the Sakarya province (Western Black Sea Region) in Turkey. This study was conducted to determine some important physicochemical characteristics, total phenolic content and antioxidant capacity of fruits from promising cherry laurel (*Laurocerasus officinalis* R.) genotypes selected in the Sakarya province of Turkey.

MATERIAL AND METHODS

Plant Materials and Determination of Biyochemical Characteristics

Twelve cherry laurel (*Laurocerasus officinalis* R.) (54KY–1–54KY–12) fruit samples were collected in the Sakarya region. The morphological characteristics of the fruits (fruit weight, fruit length and fruit width) were determined in fresh fruit samples. Fruit weight was measured with an electronic balance of 0.01 g sensitivity. Fruit juice was also analyzed for titrable acidity as malic acid was determined by titration with 0.01 mol/L NaOH using phenolphthalein as indicator and pH of fruit juices was determined following the guidelines of the official AOAC method [2].

The fruit samples were also used for ash ratio analysis. Total inorganic matters (ash percentage) were determined by incinerating the sample at 600°C [2]. Nitrogen and protein content were determined by Kjeldahl method [5]. The samples (0.5 kg) were packed in plastic bags, frozen and kept at –20°C before extraction of antioxidant activity and phenolic compounds. All chemicals and solvents used in analysis were purchased from Sigma Aldrich (Sternheim, Germany), Alfa Aesar (Karlsruhe, Germany) and Merck (Darmstadt, Germany).

Extraction

An efficient extraction procedure was crucial for the assessment of total phenolic contents and antioxidant capacity. Samples were dried then 3 g of the fine ground sample was extracted with 10 ml methanol in a flask placed in an ultrasonic bath (Hilsonic, UK) at 35°C for 15 min. The sample was cooled at room temperature and centrifuged (Sigma, Germany) at 8000 rpm for 15 min. The supernatants were transferred into new tubes respectively.

Total Phenolic Content

Methanol extracts of cherry laurel samples were measured using the method described below. Total polyphenol content was measured

using Folin–Ciocalteau colorimetric method. This method is designed for the analysis of protein as the original [22]. The FCR–based method is commonly known as the total phenols (or phenolic) method. The FCR actually measures a sample's reducing capacity [23]. Extracts were prepared before starting the analysis. The extracts were diluted 1/100 rate for analysis. The extracts (100 µl) were mixed with 0.2 ml of Folin–Ciocalteau reagent and 2 ml of H_2O and incubated at room temperature for 3 min. Following the addition of 1 ml of 20% sodium carbonate to the mixture, total polyphenols were determined after 1 h of incubation at room temperature. The absorbance of the resulting blue color was measured at 765 nm with a Shimadzu UV–VIS spectrophotometer. Quantification was done with respect to the standard curve of gallic acid (r^2:9983). The results were expressed as gallic acid equivalents (GAE), milligrams per 1 g of dry weight (dw). All analyzes were performed three replications.

Scavenging Activity on DPPH

The extracts were diluted 1/100 rate for analysis. Solutions were prepared with a concentration of 3 mg/ml for each sample. Known concentrations of 0.2 ml cherry laurel extract were taken in test tubes. Then, 3 ml of a 0.05 mM methanolic solution of DPPH was added to the tubes and shaken vigorously. The tubes were allowed to stand at 25°C for 30 min. The control was prepared without any extract and methanol was used for the baseline correction. The absorbance of the samples was measured at 517 nm. Radical scavenging activity of the extracts was calculated by the following formula [26].

$$\%\ \text{Radical Scavening Activity} = \frac{\text{Control OD} - \text{Sample OD}}{\text{Control OD}} \times 100$$

RESULTS AND DISCUSSION

This study was conducted to investigate significant physiochemical, total phenolic content and antioxidant activity selected during two years cherry laurel genotypes grown from Sakarya region. The morphologic properties of fruit are given Table 1. As can be seen from Table 1, In genotypes, cluster weight, fruit number per cluster, fruit weight, fruit length, fruit width and fruit shape index of cherry laurel genotypes varied from 21.60 to109.27 g, from 19.00 to 27.00, from 1.08 to 5.33 g, from 12.09 to 20.95 mm, from 10.58 to 21.94 mm, from 0.84 to1.14 respectively. According to fruit shape index, fruits belong to genotypes were determined as "round".

Table 1. Some morphological characteristics of selected genotypes

Genotypes	Cluster weight (g)	Fruit numbers of per cluster	Fruit weight (g)	Fruit length (mm)	Fruit width (mm)	Fruit shape index
54KY–01	92.45	21.40	4.32	17.82	21.34	0.84
54KY–02	109.27	20.50	5.33	20.95	21.94	0.96
54KY–03	53.34	21.00	2.54	16.61	15.39	1.08
54KY–04	87.32	21.83	4.00	17.78	17.48	1.02
54KY–05	58.32	27.00	2.16	16.29	15.46	1.05
54KY–06	66.34	21.33	3.11	16.79	19.52	0.86
54KY–07	101.26	20.75	4.88	18.39	19.47	0.95
54KY–08	92.72	19.00	4.88	19.47	18.39	1.06
54KY–09	89.25	20.66	4.32	20.41	19.59	1.04
54KY–10	21.60	20.00	1.08	12.09	10.58	1.14
54KY–11	76.07	21.37	3.56	17.60	17.90	1.02
54KY–12	76.75	21.32	3.60	17.56	17.87	0.98

The results of our study are in agreement with many researcher conducted other region of Turkey [1, 9, 10, 19, 20, 22, 23]. Akbulut et al. (2007) investigated that cluster weight, fruit number per cluster and fruit weight of 28 cherry laurel genotypes grown in Samsun belong to Black Sea region and reported that cluster weight ranged as 5.84–57.82 g, fruit number per cluster ranged as 3.6–18.3 and fruit weight ranged as 1.40–5.39 g [1]. Bostan and İslam have also report that cluster weight changed between 19.79 to 103.28 g, total fruit number per cluster changed between 2.85 to 7.80 and fruit weight changed between 2.06 to

6.79 g among 17 cherry laurel genotypes from grown in Trabzon province [11]. Bostan investigated pomological properties of "Su" cultivars (cherry laurel) grown in Trabzon and determined that cluster weight, fruit weight and fruit number per cluster in "Su" (cherry laurel) cultivars ranged as 46.75 g, 4.89 g and 9.85 respectively [10].

Important biochemical composition of genotypes was given in Table 2. As seen from Table 2, in fruit juice pH contents varied between from 4.43 to 4.93, acidity content between 0.22% to 0.49%, Nitrogen contents between 0.11% to 0.37%, crude protein between 0.81 to 2.31%, total dry matter rates between 17.28% to 23.55% and soluble solid content between content 15.53% to 32.30%. Similar results were also reported cherry laurel genotypes by Karadeniz and Kalkışım (1996) who reported that pH content varied between from 4.20 to 4.30, soluble solid content between from 16% to 20%, total dry matter content between from 19.0% to 20.0% and acidity between from 0.22% to 0.26% [24].

İslam (2002) who found pH content 4.55, soluble solid content 15.92% and acidity content 0.29% in 'Kiraz' (cherry laurel) cultivars [20]. Similarly, Kalyoncu et al. (2013) reported that soluble solid content; protein and crude ash contents were ranged from 20.10%, 0.29% and 0.22% respectively [23]. İslam and Vardal (2009) found soluble solid content between 15.7 and 23.1% in study conduct at Rize province [22]. Çelik et al. (2011) determine soluble solid, crude protein, ash and pH content between 9.64 and 17.10%, 1.44 and 2.09%, 0.25 and 0.71%, 4.30 and 4.93% respectively [12].

The refraction index, ash rate, total phenolic content and antioxidant activity were described in cherry laurel genotypes (Table 3). According this data, the refractive index values, which are usually important in the quality of fruit juice varied between 1.356 and 1.385 and this data, are found very close among genotypes.

The ash ratios are indicator of mineral matter content and ash contents in the genotypes ranged from 0.237% to 0.720%. The results confirmed earlier reports that ash content by Karadeniz and Kalkışım (1996), Çelik et al. (2011), Kalyoncu et al. (2011) [12, 23, 24]. They reported that ash content varied from 0.250 to 0.600. The previous findings are in agreement with our results. There were significant different among genotypes in term of phenolic content.

The total phenolic content was found between 1197 and 6801 mg GAE/100 g dw. The highest phenolic content are determined 54KY–03 genotypes, the lowest phenolic content also was found 54KY–12 genotypes. When these values are examined; there are differences according to genotypes. Nevertheless, the values obtained are close to the results of research carried out both in Turkey and abroad [3, 12, 17].

The results obtained suggest that the comparison of the results of the studies were conducted in Turkey and the international data shows that the genetically domesticated genotypes that have grown in the region constitute a promising potential and that selection studies should be continued under controlled conditions.

Table 2. Some biochemical characteristics of selected genotypes

Genotypes	pH	Titrable Acid (TAc)	Nitrogen (%)	Crude protein (%)	Dry material (%)	Soluble Solid Content SSC (%)
54KY–01	4.43±0.02	0.49±0.10	0.11±0.02	0.67±0.09	19.98±0.39	24.00±0.55
54KY–02	4.71±0.08	0.45±0.04	0.18±0.01	1.10±0.07	23.55±0.89	32.30±0.35
54KY–03	4.66±0.05	0.22±0.04	0.13±0.02	0.81±0.11	17.33±0.67	23.00±0.06
54KY–04	4.68±0.17	0.33±0.07	0.19±0.01	1.18±0.05	20.66±2.48	22.10±0.68
54KY–05	4.69±0.10	0.36±0.04	0.22±0.02	1.36±0.13	22.42±0.54	27.00±0.06
54KY–06	4.81±0.02	0.31±0.04	0.37±0.09	2.31±0.56	25.49±0.31	22.03±0.48
54KY–07	4.47±0.03	0.36±0.04	0.16±0.02	0.95±0.10	17.28±0.58	15.53±0.40
54KY–08	4.66±0.06	0.31±0.04	0.18±0.03	1.13±0.17	16.62±0.96	20.80±0.85
54KY–09	4.70±0.06	0.27±0.07	0.24±0.02	1.51±0.12	23.21±0.88	29.30±0.00
54KY–10	4.93±0.02	0.29±0.04	0.14±0.02	0.86±0.14	20.19±1.96	16.73±0.38
54KY–11	4.57±0.03	0.47±0.00	0.16±0.02	0.98±0.12	22.98±0.83	31.36±1.01
54KY–12	4.69±0.05	0.22±0.04	0.16±0.02	1.00±0.12	23.26±0.13	29.40±0.46

Table 3. Some biochemical characteristics, total phenolic content and antioxidant activity of selected genotypes

Genotypes	Refractive index	Ash (%)	Total phenolic mg GAE/100 g dw)	DPPH (%) (1/100=3 mg/ml)
54KY–01	1.370±0.001	0.720±0.002	2845±167	13.43±1.89
54KY–02	1.385±0.001	0.534±0.005	2781±1149	25.10±1.45
54KY–03	1.369±0.001	0.237±0.030	6801±108	13.24±1.61
54KY–04	1.368±0.001	0.357±0.003	4741±158	20.57±1.89
54KY–05	1.376±0.001	0.661±0.047	2907±201	10.33±3.50
54KY–06	1.364±0.001	0.710±0.070	3275±262	10.50±0.77
54KY–07	1.356±0.001	0.392±0.049	2716±411	7.05±1.65
54KY–08	1.365±0.002	0.367±0.009	1400±344	3.36±0.39
54KY–09	1.380±0.001	0.370±0.009	1817±149	7.05±0.67
54KY–10	1.358±0.001	0.283±0.012	1705±525	2.43±1.05
54KY–11	1.384±0.000	0.615±0.061	1589±73	3.78±0.51
54KY–12	1.380±0.001	0.337±0.036	1197±356	3.69±0.81

REFERENCES

1. Akbulut, M., İ. Macit, S. Ercişli and A. Koç, 2007. Evaluation of 28 cherry laurel *Laurocerasus officinalis*) genotypes in the Black Sea region, Turkey. *New Zealand Journal of Crop and Horticultural Science 35:463–465.*
2. AOAC, 1995. Official methods of analysis. *Arlington: AOAC International, pp.16–17.*
3. Alaşalvar, C.A.M. and F. Shadidi, 2005. Compositional characteristics and antioxidant components of cherry laurel varieties and pekmez. *Journal of Food Science 70(1):47–52.*
4. Alp, Ş., S. Ercişli, T. Jurıkova, O. Cakır and S. Gozlekcı, 2016. Bioactive content of rosehips of different wildly grown *Rosa dumalis* genotypes. *Not Bot Horti Agrobo 44(2):472–476.*
5. Anonymous, 2007. Gıda Maddeleri Analizi (https://www.foodelphi.com/kjendahl–metoduyla–ham–protein–tayini).
6. Atik, A.D., M. Oztekin and F. Erkoc, 2010. Biodiversity and examples of endemic plants in Turkey. *J. Gazi Edu. Fac. 30(1):219–240.*
7. Barros, L., A.M. Carvalho and I.C.R.F. Ferreira, 2010. Exotic fruits as a source of important phytochemicals: improving the traditional use of *Rosa canina* fruits in Portugal. *Food Res. Int. 44:2233–2236.*
8. Baytop, T., 1984. Therapy with medicinal plants in Turkey (past and present). *Nobel Press, İstanbul, p.353.5.*
9. Beyhan, O., 2010. A study on selection of promising native cherry laurel (*Prunus laurocerasus* L.) genotypes from Sakarya, Turkey. *J. Animal Plant Sci. 20(4):231–233.*
10. Bostan, S.Z., 2001. Pomological traits of "Su" cherry laurel. *Journal American Pomological Society 55(4):215–217.*
11. Bostan, S.Z. ve A. İslam, 2003. Trabzon'da yetiştirilen mahalli karayemiş (*Prunus laurocerasus* L.) tiplerinin pomolojik ve fenolojik özellikleri. *Ondokuzmayıs Üniversitesi Ziraat Fakültesi Dergisi 18(1):27–31.*
12. Çelik, F., S. Ercişli, S.O. Yilmaz and A. Hegedus, 2011. Estimation of certain physical and chemical fruit characteristics of various cherry laurel (*Laurocerasus officinalis* Roem.) genotypes. *Hort. Science 46(6):924–927.*
13. Demir, F., Ö. Yıldız, M. Alpaslan and A.A. Hayaloğlu, 2014. Evaluation of volatiles, phenolic compounds and antioxidant activities of rosehip (*Rosa* L.) fruits in Turkey. *Food Science and Technology 57:126–133.*
14. Ercişli, S., 2004. A short review of the fruit germplasm resources of Turkey. *Genet. Resources Crop Evol. 51:419–435.*
15. Ercişli, S., 2007. Chemical composition of fruits in some rose (*Rosa* spp.) species. *Food Chemistry 104:1379–1384.*
16. Ercisli, S. and A. Eşitken, 2004. Fruit characteristics of native rosehip (*Rosa* spp.) selections from the Erzurum province of Turkey. *New Zealand Journal of Crop and Horticultural Science 32(1):51–53.*
17. Halilova, H. and S. Ercişli, 2010. Several physico–chemical characteristics of cherry laurel (*Laurocerasus officinalis* Roem.) fruits. *Biotechnol and Biotechnology 24(3):1970–1973.*

18. Halliwell, B., 1992. How to characterize biological antioxidants. *Vol.9, No.4 Free radic. Res. Communication.*
19. Heinonen, M., A. Meyer and E. Frankel, 1998. Antioxidant activity of berry phenolics on human low density protein and liposome oxidation. *J. Agric. Food Chem. (46):4107–4112.*
20. İslam, A., 2002. "Kiraz" cherry laurel (*Prunus laurocerasus*). *New Zealand Journal of Crop and Horticultural Science 30:301–302.*
21. İslam, A., 2005. Karayemiş yetiştiriciliği ve önemi. *Ege Karadeniz Dergisi 28(4):25–32.*
22. İslam, A. and E. Vardal, 2009. Pomologıcal characteristics of cherry laurel (*Prunus laurocerasus* L.) grown in Rize. *Acta Horticulturae 818:133–136.*
23. Kalyoncu, İ.H., N. Ersoy, A.Y. Elidemir and C. Dolek, 2013. Mineral and some physico–chemical composition of 'Karayemiş' (*Prunus laurocerasus* L.) fruits grown in Northeast Turkey. *World Academy of Science, Engineering and Technology 7(6):11–14.*
24. Karadeniz, T. ve Ö. Kalkışım, 1996. Akçaabat'ta yetiştirilen karayemiş tiplerinde seleksiyon çalışması. *Yüzüncü Yıl Üniversitesi Ziraat Fakültesi Dergisi 6(1):147–153.*
25. Karan, D., 2015. Farklı karayemiş genotiplerinin (*Prunus laurocerasus* L.) depolama süresince kalite değişimlerinin belirlenmesi (Yüksek Lisans Tezi). *Ordu Üniversitesi Fen Bilimleri Enstitüsü Bahçe Bitkileri Anabilim Dalı, 58s.*
26. Kris–Etherton, P.M., K.D. Hecker, A. Bonanome, S.M. Coval, A.E. Binkoski, K.F. Hilbert, E.G. Amy and D.E. Terry, 2002. Bioactive compounds in foods: their role in the prevention of cardiovascular disease and cancer. *American Journal of Medicine 113(9):71–88.*
27. Milivojevic, J., A. Slatnar, M. Mikulic–Petkovsek, F. Stampar, M. Nikolic and R. Veberic, 2012. The influence of early yield on the accumulation of major taste and health–related compounds in black and red currant cultivars (*Ribes* spp.). *J. Agric. Food Chem. 60:2682–2691.*
28. Rodriguez–Mateos, A., D. Vauzour, C.G. Krueger, D. Shanmuganayagam, J. Reed, L. Calanı, P. Mena, D. Del Rio and A. Crozier, 2014. Bioavailability, bioactivity and impact on health of dietary flavonoids and related compounds: an update. *Arch Toxicol. 88:1803–1853.*
29. Urgenc, S., 1990. General Plantation and Afforestation Techniques. *University of İstanbul Faculty of Forestry, Issue No: 407, Istanbul.*
30. Ustun, N.S., I. Tosun and B. Gumuşhan, 2000. Suitability of Cherry laurel (*Laurocerasus officinalis* Roem) to Jam Production. *Blacksea and Central Asian Symposium on Food Technology. October 12–16, 2000. Ankara, Turkey.*
31. Yaltırık, F. and A. Efe, 1994. Dendrology. *University of Istanbul Faculty of Forestry, Issue No: 431, ISBN. 975404363–9, Istanbul.*
32. Yazıcı, K., B. Çakır and S. Kazaz, 2011. An important genetic resource for Turkey, Cherry laurel (*Laurocerasus officinalis* Roemer). *Acta Horticulturae 890:261–265.*
33. Yıldız, H., S. Ercisli, H.K. Narmanlıoglu, S. Guclu, M. Akbulut and Z. Turkoglu, 2014. The main quality attributes of non–sprayed cherry laurel (*Laurocerasus officinalis* Roem.) genotypes. *Genetika 46(1):129–136.*