ACTA SCIENTIARUM POLONORUM

Acta Sci. Pol. Hortorum Cultus, 21(6) 2022, 67–78

https://czasopisma.up.lublin.pl/index.php/asphc ISSN 1644-0692 e-ISSN 2545-1405 https://doi.org/10.24326/asphc.2022.6.6

ORIGINAL PAPER

Accepted: 5.07.2022

DETERMINATION OF PHYTOCHEMICALS OF TURKISH FIG GENETIC RESOURCES

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ABSTRACT

The rise of consumer interest in functional food make it necessary to determine the total phenolic (TP) and antioxidant activity (AOA) of the fig accessions in Türkiye. In this study, 236 fig accessions were analayzed for various metabolites such as phenolic compounds, total phenols (TP), total anthocyanins (TA), total flavonoids (TF), and total antioxidant capacity (TAC). The results showed that routine (44.34 ±8.78 mg kg^{-1} FW) was dominant phenolic compound in the fruits of 'Bursa Siyahı' variety, followed by epicatechin (27.76 ±1.12 mg kg^{-1} FW), syringic acid (4.57 ±2.20 mg kg^{-1} FW) and chlorogenic acid (4.39 ±0.20 mg kg^{-1} FW). Among the samples analysed, it was determined that the accession with the highest TPC (189.0 mg GAE 100 g^{-1} FW) and AOA (688.6 µmol troloks 100 g^{-1} FW) was 'Kepek' (TR 532). Also, it was determined that the accession with the highest anthocyanin content (512.3 mg cyn-3-glu kg^{-1} FW) was 'Siyah' (TR 230). 'Kepek' (TR532), 'Siyah' (TR 230), 'Divrekkara' (TR1101) and 'Siyah Kış' (TR1088) are generally not very cultivated accessions. These accessions have an important potential due to the continuous rise of interest in food with high AOA all around the world.

Key words: antioxidant activity, *Ficus carica*, HPLC, 'Kepek' variety, total anthocyanin, total phenolic continent

INTRODUCTION

In developed countries, food preferences and expectations of consumers tend to change. Since consumers have the expectation that food has the potential to be an alternative to medications besides their nutritional effect, the interest in functional foods is increasing day by day. In general, functional foods are foods that can improve healthy living conditions by minimizing some disease risks rather than nutritional needs [Hardy 2000]. For a food to be considered a functional food, it must contain some bioactive compounds. Phytochemicals that add functionality to foods are carotenoids, flavonoids, polyphenols, phytosterols, phytoestrogens, indoles and sulfides [Roberfroid 2000].

Natural antioxidant compounds such as phenolic compounds, organic acids, vitamin E and carotenoids can be found in different fruits and vegetables. Also, fig is rich in these compounds [Veberic et al. 2008, Viuda-Martos et al. 2015]. These compounds prevent free radical formation and offer a healthy life. The most prominent ones among these compounds are phenolic compounds. Phenolic compounds are divided into two basic groups phenolic acids and flavonoids [Chang et al. 2016, Shahidi and Ambigaipalan 2015]. Fresh or dried fig is an important source of some trace elements such as especially iron, calcium and potassium and vitamins such as especially thiamine and riboflavin [Ouchemoukh et al. 2012, Solomon et al. 2006, Viuda-Martos et al. 2015]. In recent years, scientific studies have focused on the qualitative and quantitative analysis of phenolic compounds of fresh and

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dried figs in different accessions and the distribution of these compounds in the fruit peel and pulp section [Solomon et al. 2006, Bachir Bey et al. 2013, Kamiloglu and Capanoglu 2013, Bachir Bey and Louaileche 2015, Ajmal et al. 2016, Harzallah et al. 2016, Maghsoudlou et al. 2017]. The content and amount of antioxidant compound in figs significantly depends on the genotype, maturity stage and weather conditions [Solomon et al. 2006, Çalışkan and Polat 2011, Crisosto et al. 2011]. Also, recent studies have shown to be a significant correlation between the peel colour (green, brown, purple yellow and black) of the fig and its phytochemical content and antioxidant capacity [Solomon et al. 2006, Çalışkan and Polat 2011]. Anatolia has a very rich variation in terms of fig genetic resources. So far, 273 female fig and 58 male fig types collected from 6 geographical regions of Anatolia (Aegean, Marmara, South Eastern Anatolia, Black Sea, Central Anatolia, and Mediterranean) have been taken under protection in the Fig Research Institute. Çalışkan and Polat [2011, 2012] determined the phytochemical and antioxidant properties of 'Bursa Black', 'Yellow Zeybek' and 'Yeşilgüz' accessions and 01-IM-02 genotypes as well as 76 accessions in the Mediterranean region. In addition, Ercişli et al. [2012] determined the total phenolic content (TPC) of 24 fig accessions located in north-eastern Türkiye. When it is looked at the literature, it is seen that the whole accession of figs in Türkiye is not screened for phytochemicals. This is the first attempt at assessing the phytochemical potential of 236 different fig accessions. This research aims to reveal the data regarding the total phenolic compounds and total antioxidant capacities of the accessions in the Fig Research Institute collection as well as comparatively giving the phenolic components of 'Bursa Siyahı' and 'Sarılop' varieties, which are of commercial importance, to increase the new market opportunities in line with the changing consumer demands for the accessions rich in these features, and to provide basic data for the projects planned for the biochemical properties of the fig.

MATERIAL AND METHOD

Material. 236 of the fig accessions under protection in the fig genetic resources parcel in the Fig Research Institute were used for analysis. It was formed into five groups as black, purple, brown, yellow, and green according to the peel colors during the selection of these accessions (Figs. 1 and 2). Of the 236 fig accessions analysed for TPC, 60 fig varieties, containing some prominent accessions in terms of TPC, were selected and analyzed in terms of total anthocyanin (TA) content and antioxidant activity (AOA). The analyses were carried out in three replicates and each repeat was formed by being used 15 fruits, which was obtained from each accession of figs through a random sampling method. Fruits were harvested at the edible maturity and stored for a short time at –20°C until analysis. This study was conducted repeatedly for two years and the average data of two years were used for evaluation.

Colour determination. Colour analyses were performed on 10 fruits selected randomly from L, a, and b types using a colorimeter (Minolta CR-400, Japan). Measurements were performed at 2 points of each fruit surface and the apparatus with an 8 mm display area of the colorimeter was used during measurement.

The extraction of the samples for total phenolic content and antioxidant activity. In order to obtain hydrophilic and lipophilic phenolic components, two-step extraction process was consecutively performed in accordance with the method used by Arcan and Yemenicioğlu [2009] in dried nuts. The method used by Beccaro et al. [2006] and Çalışkan and Polat [2011] was modified to determine the extraction and dilution conditions. The fruits used in each repetition were weighed as 100 g, homogenising after being crushed with a knife. 60 mL of cold pure water (4°C) is added to 100 g of homogenate, and then this mixture is blended for 2 min at high speed in a Waring blender. Then, 12 mL of pure water (4°C) is added to 2 g of the homogenate obtained after blending. After the slurry obtained was homogenized in a disperser-homogenizer (IKA-T 18, Brasil) at 18,000 rpm for 2 min, the final homogenate was centrifuged at 6000 g for 20 min at 4°C. The hydrophilic extract, the upper liquid, was separated from the pellet and kept in an ice water bath until analysed for AOA and TPC. On the other hand, after determining the weight of the pellet remaining in the centrifuge tube, it was suspended in 12 mL ethanol (96%). The resulting suspension was homogenized in the homogenizer at 18 000 rpm for 4 min. The homogenate was then centrifuged at 6000 g for 15 min at 4°C.

Fig. 1. Distribution of accessions according to colour

Peel colour	Images of accessions	Peel colour	Images of accessions
Black		Yellow	
Purple		Green	
Brown			

Fig. 2. Grouping according to the colours

The supernatant containing the ethanolic extract was collected and kept in an ice water bath until AOA and TPC analysis.

Determination of antioxidant activity. The ability to reduce free radicals of figs extracts was determined spectrophotometrically (PG, Model T80, United Kingdom) at 734 nm by being used trolox equivalent antioxidant capacity (TEAC) method [Re et al. 1999]. In the method, first, the dark blue coloured ABTS radical cation ($ABTS^{+\bullet}$) stock solution was obtained after mixing 7mM ABTS with 2.45mM potassium persulfate (oxidant) in equal volumes. ABTS solution oxidized with potassium persulfate was used after being kept in the dark for 12–16 h. Before starting the analysis, the $ABTS^{+\bullet}$ solution was first diluted with phosphate buffered saline (PBS) solution to give an absorbance value of 0.700 at 734 nm. Aliquots of 5, 10, 20 µl fig extract was added to 2 mL diluted $ABTS^{+\bullet}$ solution in the spectrophotometer cuvettes and the absorbance of the extracts was recorded at 734 nm exactly after 6 min. This process was performed separately for water and ethanol extracts. The 6th min absorbance values of the samples were compared with the initial absorbance values and the percent inhibition rates were calculated. The samples of which inhibition rate was not between 20–80 percent were re-analysed by adjusting the sample quantity. Percent inhibition values corresponding to each quantity of the sample were graphed and linear regression analysis was performed to achieve the curve related to the sample and the equation defining this curve. The curves of the samples were proportioned to the standard curve prepared for trolox, and the TEAC values of the samples were calculated. The AOA of the fig samples were determined as µmol trolox 100 g^{-1} FW by being found the sum of the values of the aqueous and ethanolic extractions.

Determination of total phenolic content. TPC of fig extracts was determined spectrophotometrically using Folin-Ciocalteu (FC) method [Singleton and Rossi 1965]. This method is a redox reaction in which phenolic compounds reduce the Folin-Ciocalteu reagent in alkaline medium and turn into an oxidized form. 1 mL of aqueous and ethanolic extracts was mixed with 5 mL 2 N (10%) Folin-Ciocalteu reagent and the mixtures were incubated in dark for 3 min. After 4 mL of 0.7 M sodium carbonate was added to the mixture, the mixture was mixed with a vortex. After 2 h of incubation at room temperature and at dark, the absorbance at 765 nm of the mixture was spectrophotometrically measured. Compared to the curve of gallic acid standards prepared at different concentrations, the measurements were calculated as mg GAE (gallic acid equivalent) 100 g^{-1} FW. The TPC in the fig samples was found by calculating the sum of phenolic contents of their aqueous and ethanolic extracts.

Determination of total anthocyanin. The pH differential method was used to determine the total amount of anthocyanins [Cheng and Bren 1991]. According to the method, 2 g of the samples was homogenized with 10 mL of acidified ethyl alcohol (pH 1.0) and then the resulting homogenates were centrifuged at 6000 rpm for 20 min. 1 mL of supernatant was placed in each of 2 test tubes. 0.025 M potassium chloride buffer solution (pH 1.0) was added to the first tube and 0.4 M sodium acetate buffer solution (pH 4.5) were added to the second tube. After both samples were passed through a 0.45 µm PTFE filter, their absorbances at 510 nm and 700 nm were measured in the spectrophotometer. TA content was calculated using the molecular weight and molar absorption coefficient of the major anthocyanin (cyanidin-3-glucoside) in the sample matrix. The values were given as cyn-3-glu kg^{-1} FW.

Phenolic component analysis. Phenolic components were analyzed in HPLC according to the method described by Nakilcioğlu [2013]. Extracts prepared for TPC and AOA were passed through a 0.45 µm diameter PVDF (polyvinylidene fluoride) filter (Millipore, Bedford, MA, U.S.A) before analysis. Phenolic components were analysed by HPLC (Shimadzu LCA20A). To achieve a comparison curve in the device, a mix standard series consisting of 1, 3, 5, 10, 25, 50 and 100 mg L^{-1} of epicatechin, chlorogenic acid, gallic acid, syringic acid and rutin stock solutions was formed. HPLC device features and chromatography conditions: column: C18 – 5 µm, 250 × 4.6 mm (Macherey-Nagel, Germany); flow rate: 0.4 mL min^{-1}; injection quantity: 20 µL; column temperature: 40°C; detector: PDA-SPD-M20A, λ = 254, 272, 275, 279, and 356 nm; mobile phase: ultra-pure water with 2% acetic acid (A), methanol (B).

Statistical analysis. The results were evaluated by variance analysis using the least significant difference

– LSD ($p \leq 0.05$) to determine differences between the groups. The relationship between the variables was determined by correlation analysis. The statistical analyses were performed with JMP (statistical software).

RESULTS AND DISCUSSION

In this study, female fig accessions located in Fig Research Institute that maintain fig genetic resources in Türkiye were examined in terms of bioactive components and AOA. TPC analysis for 236 accessions suitable for sampling in genetic sources was done. TA and AOA were determined in 60 samples containing some of the accessions with the highest TPC and some of the most common cultivars regardless of their TPC. In our study, the results of the phenolic compound analysis of 'Sarılop', the most common fig accession grown to be consumed as dried, and 'Bursa Siyahı', the most common fig accession grown to be consumed as fresh are shown in Table 2. The phenolics analyzed in our study were epicatechin, chlorogenic acid, gallic acid, syringic acid, rutin with a statistically significant level $p < 0.05$ (Tab. 1). The recovery factors and the values of LOD and LOQ are shown in Table 1.

Among the phenolic compounds analyzed, rutin (44.34 ±8.78 and 37.21 ±7.67 mg kg^{-1} FW) was dominant in the 'Bursa siyahı' and 'Sarılop' varieties fruits. Besides, in terms of amount, rutin in 'Bursa Siyahı' was respectively followed by epicatechin (27.76 ±1.12 mg kg^{-1} FW), syringic acid (4.57 ±2.20 mg kg^{-1} FW), chlorogenic acid (4.39 ±0.20 mg kg^{-1} FW) and gallic acid (1.84 ±0.25 mg kg^{-1} FW). This order in 'Sarılop' respectively changed to syringic acid (14.66 ±0.85 mg kg^{-1}), chlorogenic acid (6.27 ±0.80 mg kg^{-1}), epicatechin (6.00 ±0.50 mg kg^{-1}) and gallic acid (0.30 ±0.07 mg kg^{-1}).

Considering the results, upon comparison to 'Bursa Siyahı', it can be seen that while 'Sarılop' has higher concentrations of chlorogenic acid and syringic acid, its epicatechin, gallic acid and rutin concentrations are lower. Pereira et al. [2017] noted that high amounts of chlorogenic acid existed in brown-, green-, and yellow-green-coloured accessions both in skin and flesh. Veberic et al. [2008] also found that the figs growing in the coastal region of Slovenia showed the most abundant phenolic compound was rutin (28.7 mg kg^{-1}

Table 1. LOD (limit of detection), LOQ (limit of quantification)and recovery values in high pressure liquid chromatographic analysis

Phenolic compound	LOD (mg L^{-1})	LOQ (mg L^{-1})	Recovery for fresh fig (%)
Epicatechin	0.76	2.53	105.61
Chlorogenic acid	0.51	1.69	98.96
Gallic acid	0.25	0.82	98.12
Syringic acid	0.99	3.31	119.50
Rutin	0.14	0.46	97.15

Table 2. Phenolic component data of the most common accessions ('Sarılop' and 'Bursa Siyahı')

Accession name	Epicatechin (mg kg^{-1})	Chlorogenic acid (mg kg^{-1})	Gallic acid (mg kg^{-1})	Syringic acid (mg kg^{-1})	Rutin (mg kg^{-1})
'Sarılop' (TR1029)	6.00 ±0.50	6.27 ±0.80	0.30 ±0.07	14.66 ±0.85	37.21 ±7.67
'Bursa Siyahı' (TR237)	27.76 ±1.12	4.39 ±0.20	1.84 ±0.25	4.57 ±2.20	44.34 ±8.78

FW), which are in full agreement with our findings. Del Caro and Piga [2007] found that rutin concentration was very high in the black accession compared to the green accession in the study carried out by using two different fig types, black and green. They also stated that the rutin concentration in phenolic components was higher than in other components in the same study. The results are consistent with those of our study.

The TPC and AOA of the samples were determined by the sum of the analysis results of the hydrophilic and ethanolic fractions obtained by successive extractions. The phenolic content obtained by water extraction is 1.3 to 6 times higher than those of ethanolic, and has an average of 3.8 times in 236 samples. Similarly, in AOA analysis, the AOA of hydrophilic extracts is 1.2 to 2.5 times higher than those of ethanolic, and has an average of 3.8 times in 60 samples. In the study that Arcan and Yemenicioğlu [2009] done with hazelnuts, walnuts and pistachios, it was determined that the ratio between the water and ethanol extracts of samples was between 1.1 and 9.9 for TPC and 1.2 and 6.2 for AOA. In the study that Pereira et al. [2017] conducted to determine total antioxidant activity in the pell and pulp sections of figs, they determined that hydrophilic total antioxidant activity was higher than lipophilic total antioxidant activity in both peel and pulp samples of all accessions they used. The obtained data, which are compatible with the results of the other researches, revealed that in figs, the phytochemical components with hydrophilic properties are higher than ethanolic ones. Fig samples grouped according to the colour of the peel showed statistically significant differences in terms of their phytochemical content (Tab. 3). Black figs were determined to have the highest values in terms of TPC (110.2 mg GAE 100 g^{-1} FW), TA (216.9 mg cyn-3-glu kg^{-1} FW) and AOA (385.8 µmol trolox 100 g^{-1} TA). As a result of the analyses of all samples, it was determined the highest and lowest values of TPC (19.3 and 189.0 mg GAE 100g^{-1} FW), TA (not detected – ND and 512.3 mg cyn-3-glu kg^{-1} FW), and AOA (110.0 and 688.6 µmol trolox 100 g^{-1} FW). The wide range of values is due to the rich diversity of fig genetic resources in Türkiye. Similar results were also obtained in the study that Çalışkan and Polat [2011] conducted using 76 fig accessions growing in Türkiye. The increase in phytochemical content and AOA in parallel with the darkening of the fruit peel colour in fig was also determined in other studies

Table 3. Phytochemical contents of accessions according to peel colourPeel colour

	TP mean ±SE min–max N	TA mean ±SE min–max N	AOA mean ±SE min–max N
Black	110.2 ±7.5 a* 57.7–189.0 23	216.9 ±26.2 a 69.2–512.3 21	385.8 ±31.0 a 177.8–688.6 21
Purple	79.0 ±4.1 b 48.5–118.8 21	139.7 ±15.0 b 27.0–204.4 14	274.3 ±22.3 b 194.5–500.0 14
Brown	70.9 ±2.4 c 19.3–116.1 44	88.0 ±16.5 c 40.0–175.0 10	209.3 ±28.4 bc 115.0–385.0 10
Yellow	66.6 ±2.8 d 42.6–105.8 26	29.7 ±5.2 d ND–43.0 5	167.8 ±13.3 c 130.0–201.0 5
Green	65.1 ±1.2 d 41.0–103.7 122	35.5 ±8.7 d ND–79.5 10	168.4 ±15.5 c 110.0–271.7 10

* Columns are grouped by LSD 95% confidence level
N – number of accessions (the analyses were performed in 3 replicates for each accessions), SE – standard error

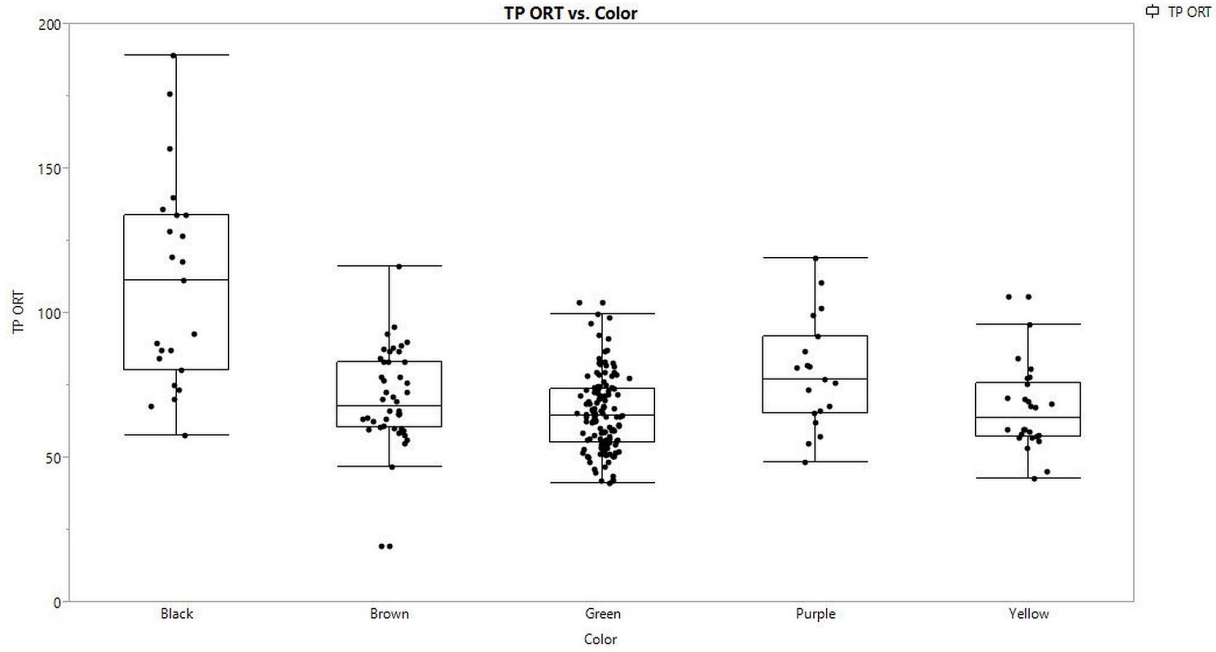

Fig. 3. TP (total phenolic) distribution of accessions according to the outer peel colour (N: 236)

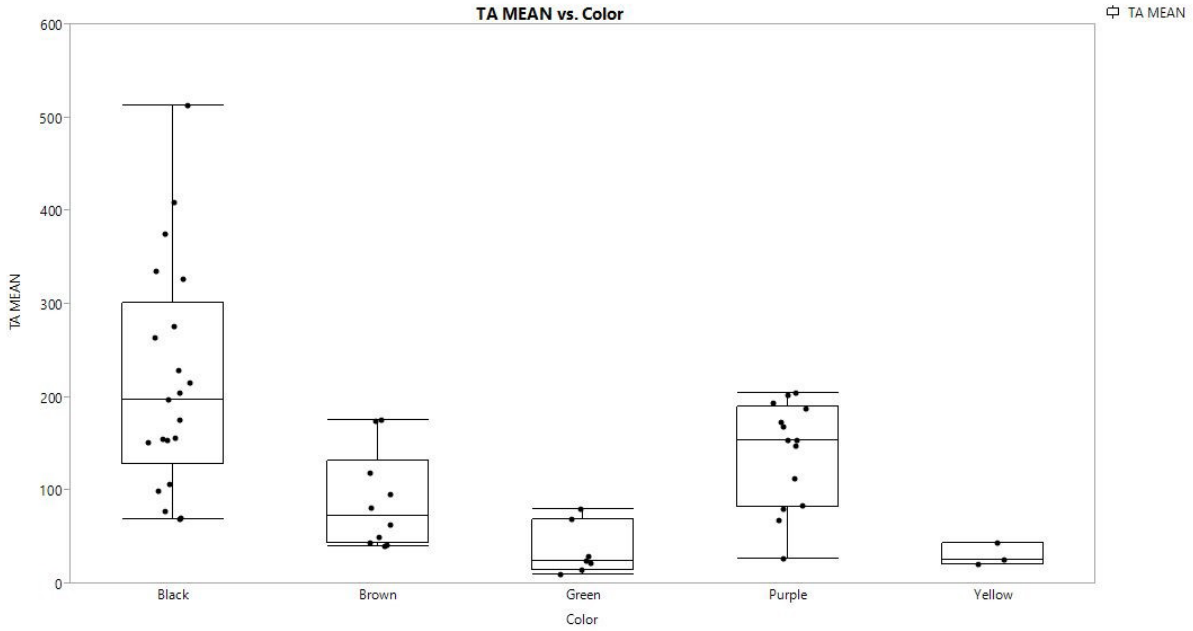

Fig. 4. TA (total anthocyanin) distribution of accessions according to the outer peel colour (N: 60)

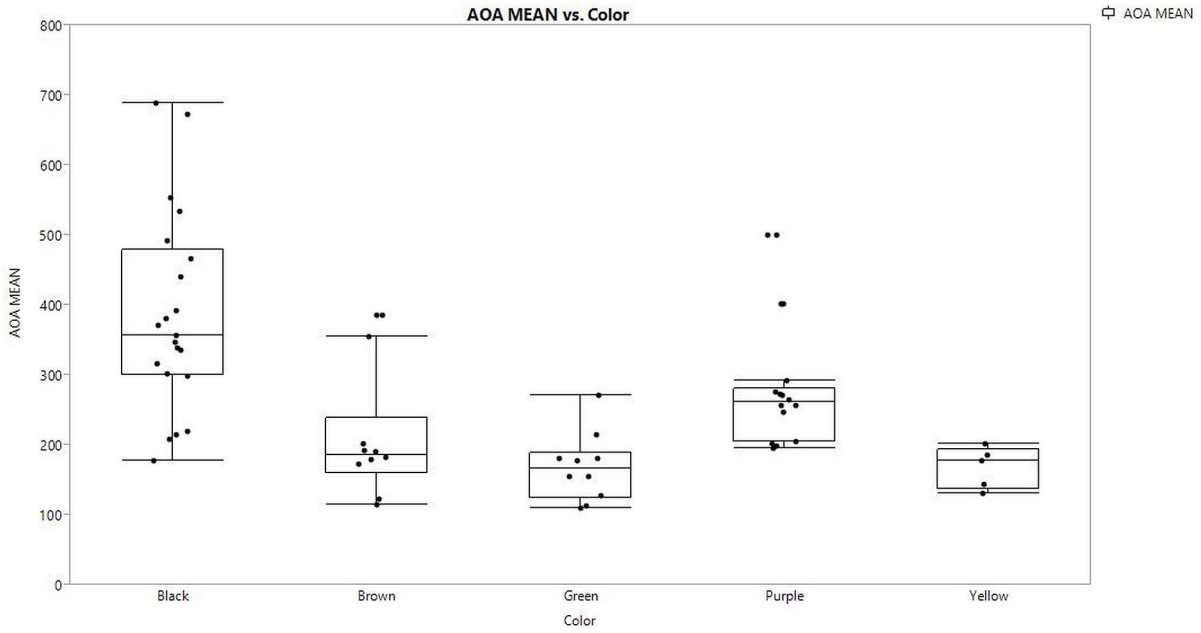

Fig. 5. AOA (antioxidant activity) distribution of accessions according to the outer peel colour (N: 60)

showing similarity to the results of this study [Solomon et al. 2006, Calıskan and Polat 2011, Pereira et al. 2017, Zhang et al. 2020].

According to the fruit peel colour in fig, it was determined that there were significant differences in terms of AOA (up to 6 times), TA (up to 19 times) and TP (up to 4.5 times) (Figs. 3–5). These results are in parallel with the results that Ercişli et al. [2012] and Solomon et al. [2006] were obtained. Maximum TP (130.7 GAE 100 g^{-1} FW), TA (79.5 mg cyn-3-glu kg^{-1} FW), AOA (271.7 µmol trolox 100 g^{-1} FW) values of some accessions with green peel colour are higher than those of accessions with some yellow, brown, purple and even black peel colour. Likewise, some accessions with dark peel colour have lower phytochemical content than light coloured accessions. In our study, although the selection of the samples was made according to the peel colour of fig, there were the accessions with a light peel and dark pulp colour, or dark peel and light pulp colour. This difference suggests that it should be evaluated the peel and pulp section separately for a species with a high genetic variation like fig in future studies. Although it varies according to accessions, it was determined that the total antioxidant activity in the peel section of fig was two to 10 times more than that of the pulp section [Pereira et al. 2017].

In the study that Pereira et al. [2017] carried out on TP and AOA of figs with different peel colours such as dark, purple, brown, green, and yellow-green, they revealed that bioactive compounds and antioxidant activities were higher in dark-coloured fruits compared to light-coloured fruits.

In our study, TP, TA and AOA valuesshow a large distribution according to the outer peel colour of the fig fruits (Figs. 3–5). In general, fig accessions with dark peel colour have higher values in terms of TP, TA and AOA values than light ones.

Among the samples analysed, it was determined that the accession with the highest TP content (189.0 mg GAE 100g^{-1} FW) and AOA (688.6 µmol trolox 100 g^{-1} FW) is 'Kepek' (TR 532). In terms of anthocyanin content, 'Siyah' variety (TR 230) is on the ranks first with 512.3 mg of cyn-3-glu kg^{-1} FW (Tab. 4). Among 76 fig accessions that Çalışkan et al. [2011] collected from Türkiye's the Eastern Mediterranean and Hatay region, they detected that 'Siyah 5' had the highest TP (211.9 mg GAE 100 g^{-1} FW), TA (298.9 µg cy-3-rutinoside g^{-1} FW) and AOA

(16.1 mmol Fe^{2+} kg^{-1} FW) values. Pereira et al. [2017] detected that the highest TP value in Spanish accessions was 169.5 GAE 100 g^{-1} FW. The analysis results of 9 accessions commonly used, and 4 accessions with both high phytochemical content and superior general properties are shown in Table 4. Among these accessions, generally, 'Kepek' (TR532), 'Siyah' (TR 230), 'Divrekkara' (TR1101) and 'Siyah Kış' (TR1088) are not considerably cultivated. The rise of cultivation of these accessions which are superior in terms of their bioactive components compared to other accessions will contribute positively to the health of consumers. These accessions can be sources that will be able to meet the increasing demand for foods with high AOA all around the world. In Türkiye, while the most common fig accession grown to be consumed as dried is 'Sarılop' (TR1029), the most common fig accession grown to be consumed as fresh is 'Bursa Siyahı' (TR237). TP and AOA values in the fresh fruits of 'Sarılop' accession (TR1029) was detected as 55.5 mg GAE $100g^{-1}$ FW and 178.06 µmol trolox $100g^{-1}$, respectively. Also, Nakilcioğlu et al. [2013] detected that TP value for 'Sarılop' accession varied in the range of 200 to 307 mg GAE $100g^{-1}$ DW. When the values in this study are calculated as FW, the TP values fall within the range of 39 to 61 mg GAE 100 g^{-1} FW and correspond to the TP values in our study. While TP values of 'Bursa Siyahı', 'Sarı Zeybek' and 'Yeşilgüz' accessions in the study by Çalışkan et al. [2012] were 118.4, 76.4 and 86.6 mg GAE 100 g^{-1} FW, respectively, the TP values of these accessions in our study were detected as 76.4, 58.9 and 73.4 mg of GAE 100 g^{-1} of FW, respectively, showing a decrease. While AOA values of 'Divrekkara' (TR1101), 'Sarılop' (TR1029) and 'Sarı Zeybek' (TR1098) accessions were 335, 178.06 and 144.04 µmol trolox 100 g^{-1} FW, respectively, AOA values belonging to the same accessions in the study by Konak et al. [2015] were determined as 208, 70 and 99 µmol trolox 100 g^{-1} FW. When compared to the studies of the other researchers, TP and AOA values obtained from the same accessions vary in the range of 15 to 60 %. The reason for this difference can be explained by many variable factors such as growing conditions, ecological effect and harvest time.

In the correlation analysis performed in 60 of the fig accessions, it was observed that there was a positive relationship between their AOA, TP and anthocyanin values (Tab. 5). Likewise, there is a strong correlation

Table 4. Phytochemical content of some accessions having a potential to become widespread because of their high phytochemical content, and some important fig accessions

Code	Peel colour	Accession name	TP ±SE (mg GAE 100 g^{-1} FW)	TA ±SE (mg cyn-3-glu kg^{-1} FW)	AOA ±SE (µmol troloks 100 g^{-1} FW)
TR532	blacksiyah	'Kepek Inciri'	189.0 ±10,5 a	326.1 ±12.2 b	688.6 ±7.0 a
TR230	black	'Siyah'	142.5 ±9.6 b	512.3 ±20.3a	672.9 ±11.7 a
TR1101	black	'Divrekkara'	144.0 ±7.9 b	214.9 ±9.8 c	335.0 ±5.7 c
TR1012	black	'Siyah Orak'	124.3 ±8.9 b	375.2 ±10.3 b	466.4 ±5.9 b
TR1088	black	'Siyah Kış'	118.7 ±3.2 b	106.0 ±3.1 d	346.0 ±1.8 c
TR237	purple	'Bursa Siyahı'	76.4 ±3.4 c	82.4 ±0.8 e	257.2 ±0.5 d
TR1008	green	'Yeşilgüz'	73.4 ±1.2 c	79.5 ±8.5 ef	214.0 ±4.9 e
TR253	green	'Sultan Selim'	64.9 ±1.7 d	69.5 ±1.3 f	271.7 ±0.8 d
TR1045	brown	'Morgüz'	59.0 ±0.6 d	43.7 ±6.4 g	122.3 ±3.7 h
TR1098	yellow	'Sarı Zeybek'	58.9 ±1.1 d	ND	144.04 ±1.8 gh
TR1029	yellow	'Sarılop'	55.5 ±1.8 e	ND	178.06 ±3.1 f
TR1080	green	'Bardacık'	53.3 ±0.8 f	22.04 ±6.5 h	136.23 ±3.8 gh
TR1001	green	'Göklop'	51.0 ±4.10 g	29.11 ±8.5 h	155.03 ±4.9 fg

* Columns are grouped by LSD 95% confidence level

Table 5. Correlation analysis

Variables		Correlation coefficient	Confidence level
TA	TP	0.6692	<0.0001
AOA	TP	0.7934	<0.0001
AOA	TA	0.8618	<0.0001

Table 6. Colour parameters according to the colour of the fruit peel

Peel colour	L ±SE	a ±SE	b ±SE	Hue ±SE	Chroma ±SE
Black	35.32 ±0.77 e*	5.02 ±0.48 c	–0.3 ±0.51 e	281.74 ±4.60 a	6.63 ±0.16 e
Purple	40.76 ±1.55 d	8.09 ±0.67 a	8.67 ±0.56 d	46.98 ±1.95 e	14.45 ±0.64 d
Brown	52.82 ±0.61 c	6.16 ±0.22 b	25.15 ±0.59 c	76.24 ±1.48 d	27.66 ±0.52 c
Yellow	72.95 ±0.63 a	–11.29 ±0.36 d	53.94 ±1.08 a	98.94 ±1.11 c	55.28 ±0.56 a
Green	68.32 ±0.31 b	–12.62 ±0.29 e	47.41 ±0.28 b	180.27 ±1.20 b	49.53 ±0.35 b

* Columns are grouped by LSD 95% confidence level

between the phenolic substance content and antioxidant capacity in other studies on figs [Solomon et al. 2006, Veberic et al. 2008]. In the study by Çalışkan and Polat [2011], there is a correlation coefficient of 0.63 at 99% confidence level between TA and AOA, a correlation coefficient of 0.73 at 99% confidence level between TP and TA, and a correlation coefficient of 0.74 at 99% confidence level between AOA and TP. The correlation coefficients between TA / AOA (0.8618), TP / TA (0.6692), and AOA / TP (0.7934) in our study correspond to those of Çalışkan and Polat [2011].

The fig fruits used in our study were divided into 5 groups visually according to their peel colours and then analysed. However, the measurements in Table 6 to reveal quantitative colour properties and to determine the difference between groups were carried out. When the statistical differences between the groups are examined, it is seen that the colour parameters supporting the visual selection are L and Chroma. The quantitative colour values of the groups in our study, which examine the figs according to peel colour, closely correspond to the values obtained by Çalışkan and Polat [2011].

CONCLUSIONS

In recent years, the interest in functional food have been increasing day by day due to the fact that individuals have been fed according to their medical condition and some food has been considered as an alternative to drugs as well as nutrition. Fig is a functional fruit to meet these demands and has accessions with very rich phytochemical content. Through this study, total phenolic compounds, anthocyanins and antioxidant activity of fig accessions categorized according to skin colour in Türkiye were determined as hydrophilic and lipophilic. The amounts of rutin analyzed in our study, are quite high and rutin could be important for the nutritional value of figs. The results of this research contribute to finding the place that fig deserves as a super fruit and suggest that it should be evaluated the potential of fig accessions rich in phytochemical properties.

ACKNOWLEDGEMENTS

The authors thank to Prof. Dr. Ahmet Yemenicioğlu for their scientific contribution to our study.

SOURCE OF FUNDING

The authors are thankful to financial supports by General Directorate of Agricultural Research, Türkiye (Project No: TAGEM/GY/11/03/01/184).

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