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Antioxidant Activity of Some Dried Autochthonous Albanian Fig (*Ficus carica*) Cultivars

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ABSTRACT

The aim of this paper is to evaluate the phytochemical character and total antioxidant capacity of sun-dried autochthonous fig cultivars commercially most known in Albania. Samples of five fig cultivars such as Roshnik, Rotllar, Bishtgjati, Melacak, and Perdhikuli, respectively cultivated in Berat, Tirana, Elbasan, Shkodra and Himara in Albania, were taken under consideration. The methanol extracts of dried fruits of each autochthonous fig cultivars were analysed to determine their total polyphenols content, anthocyanin and flavonoids content; the antioxidant activity using DPPH (1,1-diphenyl-2-picryl hydrazyl) and ABTS (2,2'-azinobis- (3-ethylbenzothiazoline-6-sulfonic acid), was evaluated too. The data obtained showed that the samples had total polyphenols content varied from 45.24-160.42 GAE mg/100 g DW of sample, the anthocyanin from 0.0-5.32 mg cyn-3-glu/100 g DW of the sample and flavonoids from 18.31-36.95 mg (+) catechin/100 g DW of the sample. Antioxidant activity expressed as DPPH varied from 387-825 mol TE/100 g DW of sample, while ABTS values ranged from 309-886 mol AAE/100 g DW of sample. The result of this study are the first data published for autochthonous Albanian fig cultivars, and showed that the selected dried fig are a good source of antioxidants. The results of this study are the first data published for autochthonous Albanian fig cultivars, and showed that the selected dried figs are a good source of antioxidants. There were seen significant differences between dark and light fig cultivars in total polyphenolic, total flavonoid, total anthocyanin content, and antioxidant capacity. The data obtained are similar to other studies about sun dried figs.

Key words: Antioxidants, Autochthonous, ABTS, DPPH, Dried fig

INTRODUCTION

Figs (*Ficus carica* L.) are a widespread species commonly grown, especially in warm, dry climates. The ideal condition for intensive cultivation of figs is a semidried climate with irrigation. They are spread mainly in Mediterranean countries, where they occupy an important role of the Mediterranean diet, which is considered to be one of the healthiest and is associated with longevity (Trichopoulou et al., 2006).

Figs are widely consumed fresh, as they naturally have a short post-harvest life; also they are very popular as dried fruit. Sun-drying prolongs their storability, requiring low capital, simple equipment and low energy input, is the conventional method used to obtain dried figs (Piga et al., 2004).

Recently, there has been extensive research into the effect of processing on antioxidants of various fruits including the influence of sun-drying on figs (Slatnar et al., 2011). *Ficus* species are rich source of naturally occurring antioxidants of which phenolic compounds and flavonoids play a vital role in preventing health disorders related to oxidative stress, including cardiovascular diseases (Sirisha et al., 2010). Figs are delicious dried fruit consumed and had a special place to the nutrition. In recent years, several data have been generated on the polyphenol compounds in a variety of food materials, including figs. Phenolic compounds,

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flavonoids, anthocyanin's, and related total antioxidant activities based on chemical extraction have typically been measured using methanol or methanol/water mixtures (Solomon et al., 2006; Veberic et al., 2008; Caliskan & Polat, 2011; Del Caro & Piga, 2008; Duenas et al., 2008). Phenolic compounds are important constituents, because of their contribution to the taste, color and nutritional properties of fruit. Phenolic compounds might have also anti mutagenic or anti carcinogenic, anti-inflammatory, or antimicrobial activities (Eberhardt et al., 2000; Kim et al., 2000). Solomon et al. (2006) showed that the higher the polyphenol content, particularly anthocyanins, in fig fruit, the higher their antioxidant activity. The functionality of these compounds is mainly expressed in their scavenging free oxygen radicals, which are involved in many pathological conditions (Briviba & Sies, 1994; Tadić et al., 2008; Hasan et al., 2010).

There are no studies investigating the effect of sun-drying on polyphenols of figs, even have not been compared among Albanian fig cultivars the. Phytochemical characters such as total phenols, total anthocyanins, total antioxidant capacity. This work is the first attempt in evaluating phytochemical qualities of sun-dried autochthonous Albanian fig cultivars green, yellow, brown, purple and black-fruited colors.

MATERIALS AND METHODS

Plant Material

Fresh fig fruits (*Ficus carica L.*) of five autochthonous cultivars as one of the best quality variety for drying, named *Perdhikuli* of Himara (yellow), *Roshnik* of Berat (green), *Melacak* of Shkodra (brown), *Bishtgjati* of Elbasan (purple) and *Rotllar* of Tirana (black), were collected in the Albanian regions of Tirana, Berat, Elbasan, Shkodra and Himara. Fruits were harvested at their optimal ripening time, during August-September 2015. For each variety, three repetitions were carried out with 50 to 60 fruits per repetition. The natural sun-drying is commonly employed for drying of figs in Albania, and the drying procedure were such that fruits were uniformly spreaded on stainless steel trays in a single layer to be exposed to the sunlight (Kamiloglu and Capanoglu, 2015). Drying process took about 8 days, and day average temperature was 34^{o}-37^{o}C. All samples were analyzed in triplicate, and the average values were calculated.

Extracts Preparation

3 ± 0.001 g of each grinded fig samples was extracted with 22.5 ml of 80% (v/v) aqueous-methanol and vortexed for 15 min (VV3, VWR international**)**. Then were centrifuged (Eba 21, Hettich) for 30 min at 3000 rpm and the supernatant was collected to be analyzed.

Chemicals

All chemicals used were analytical grade, and purchased from different sources (Fisher, Sigma-Aldrich, Fluka, Merck, and VVR).

Analyses

Moisture content was determined following AOAC ref. 934.06 (AOAC, 2000).

Determination of Total Phenolic Content (TP)

Total content of the phenolic compounds from the extracts were determined according to the method of Singleton and Rossi's (1965) with some modification and expressed as mg of gallic acid equivalent (GAE) per 100 g DW of

sample. An aliquot (500µl) of extract was mixed with 1 ml ethanol, 5 ml dH_2O, and 500 µl of Folin Ciocalteu's reagent and vortexed for 30 sec. Then 500 µl of 20% sodium bicarbonate was added to this mixture and incubated at room temperature for 30 min. Absorbance was measured at 760 nm using a spectrophotometer.

Determination of Total Flavonoid Contents (TF)

The TF was measured colorimetric ally (Zubair et al., 2013). 1 mL of extract was placed in a 10 mL volumetric flask, then added distilled water 5 mL and 0.3 mL of 5% $NaNO_2$ was added to each volumetric flask initially; after 5 min, 0.3 mL of 10% $AlCl_3$ was added. After another 6 min, 2 mL of 1 M NaOH was added and made up to 10 ml the volume with distilled water. Then solution was mixed. At 510 nm absorbance of the reaction mixture was taken using a spectrophotometer (Bichrom, UK,). Total flavonoid content was evaluated as (+) catechin equivalents (CE mg/100 g of dry weight of fruit).

Determination of Total Anthocyanins (TA)

Total anthocyanin (TA) content was quantified according to the pH differential method (Cheng and Bren, 1991). Absorbance was measured at 520 and 700nm in buffers at pH 1.0 and pH 4.5 where:

$$A = (A_{520}–A_{700})_{pH\ 1.0} − (A_{520}–A_{700})_{pH\ 4.5.}$$

The TA of extracts was expressed as mg of cyanidin-3-glucoside (C3G) equivalent per 100 g of DW of sample, (molar extinction coefficient of 26.900 and molecular weight of 449.2).

Determination of Antioxidant Activity
ABTS Radical Scavenging Assay

The antioxidant capacity of extracts was determined as ABTS radical scavenging activity (Re R. et al., 1999) The ABTS [2,2-azinobis-3- ethylbenzothiazoline-6-sulfonic acid] radical cation was produced by mixing ABTS with potassium persulfate and the mixture was kept for 16 h in the dark at room temperature before use. For the analysis, the reagent was diluted in ethanol until the absorption at 734 nm was 0.7± 0.02. A 10 µl of extract was mixed with 990 µl of ABTS reagent. The absorption was measured after 6 min of addition using spectrophotometer (Bichrom LTD, UK). The ABTS radical scavenging activity percentage of the extract was compared to ascorbic acid which was used as standard was expressed as mol AAE/100 g DW of sample.

DPPH Radical Scavenging Assay

DPPH radical scavenging capacity of fig extracts was performed according to the methods of Sun et al. (2007) with some modifications. 15, 30, 45 µl of sample extracts and 30 µl of Trolox were completed to 2 ml with 0.1 mM DPPH. The mixture was vortexed for 20 sec. The absorbance was measured at 515 nm after 20 min incubation at room temperature and dark area. 2 ml of 80% methanol was used as a blank solution. The absorbance of DPPH (2 ml) was $A_{control}$. The inhibition percentage of the absorbance was calculated as follows:

$$\text{Inhibition \%} = (A_{\text{control}} − A_{\text{sample}})/A_{\text{control}}$$

The amount of sample necessary to decrease the absorbance of DPPH by 50% (IC_{50}) was calculated graphically. The antioxidant activity was expressed as mol TE/100 g DW of sample.

RESULTS AND DISCUSSION

All figs used in the study were of *Ficus carica* and included varieties from the lightest-skinned fruits to the darkest.

Figure 1: Autochthonous fig cultivars (Photos L. Hoxha)
(respectively Roshniks, Perdhikuli, Bishtgjati, Melacak, Rotllar)

Perdhikuli and Roshniks are characterized by their small size, light color, soft texture, red flash, whereas Melacak, Bishtagjati and Rotllar are known for their medium size, large dark-colored firm skin.

Climatic conditions prevailing in Berat (Roshnik), Elbasan (Bishtgjati), Tirana (Rotllar), Shkodra (Melacak), and Himara (Perdhikuli) especially in summer during fruit maturation and drying period play a crucial role on final quality.

Table 1. Results of evaluated parametres of dried fig.

Fig varieties	MC	TP	ABTS	DPPH	Flavonoids	Anthocyanin
	%	GAE mg/100 g DW	mol AAE/ 100g DW	mol TE/100 g DW	(+) catechin mg/100g DW	mg C3G/100gDW
Roshnik	25.6	82.07	353	387	20.17	0
Perdhikuli	28.89	67.21	271	387	19.14	0.63
Bishgjati	26.075	45.24	309	459	18.31	0.28
Melacak	20.695	160.42	566	721	31.98	5.32
Rotllar	23.18	112.15	866	825	36.95	4.45

In the (Table 1) are expressed the results of moisture content, total phenolic content, antioxidant capacity, total flavonoid content, total anthocyanin content, for green-, yellow-, purple-, brown-, and black- figs taken under the study. The results of this paper represent the first published data describing the phytochemical characters and total antioxidant capacity of selected autochthonous Albanian fig cultivars, that exhibited great diversity in levels of TA (0.0–5.32 mg cyn-3-glu/100g DW), TP (45.24-160.42 mg GAE/100 g DW), TF (18.31-36.95 (+) catechin mg/100g DW), and consequently total antioxidant capacity (TAC) estimated by two different assays ABTS and DPPH, ranged respectively 309-886 mol AAE/ 100g DW, and 387-825 mol TE/100 g DW.

All green, brown and yellow colored figs were found to be diverse in terms of phytochemical characters. The differences in phytochemical characters in figs may be due to differences in the region of agriculture and the type of cultivar used. The research results determined that Melacak variety has highest TP value (160.42 mg GAE/100 g DW), while Bishtgjati result in lowest TP value (45.24 mg GAE/ 100 g DW). Rotllar variety showed the highest values of antioxidant activities 866 mol AAE/ 100g DW (ABTS assay), and 825 mol TE/100 g DW (DPPH assay), while Perdhikuli has the lowest value of antioxidant activities 271 mol AAE/ 100g DW from ABTS assay, and 387 mol TE/100 g DW from DPPH assay.

Results showed that figs are rich sources of phenolic compounds, where black fig

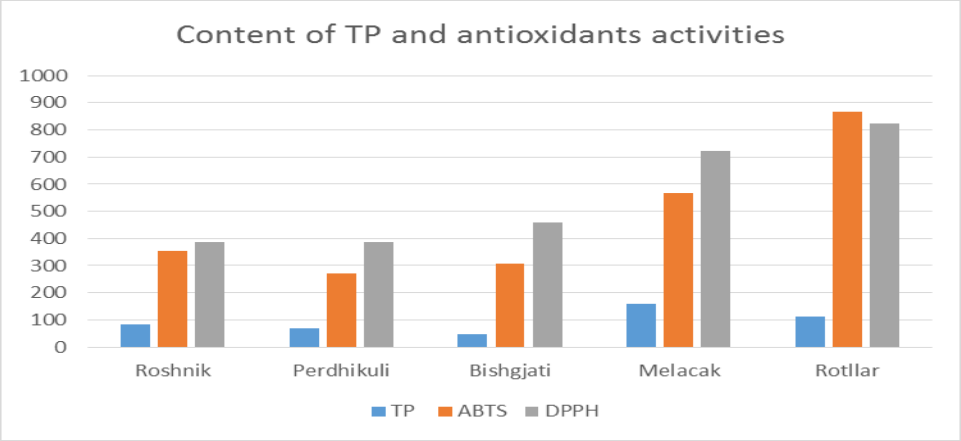

Figure 2: Total polyphenolic content, DPPH and ABTS scxavening activity.

were richer in phenolic material compared to yellow figs, consequently darker figs showed high values of antioxidant activities compared to light figs. TA was not detected in Roshnik cultivars, while Melacak showed the highest value 5.32 mg C3G/100g DW. Also dark figs had more TP, TA, and TF compared to light figs.

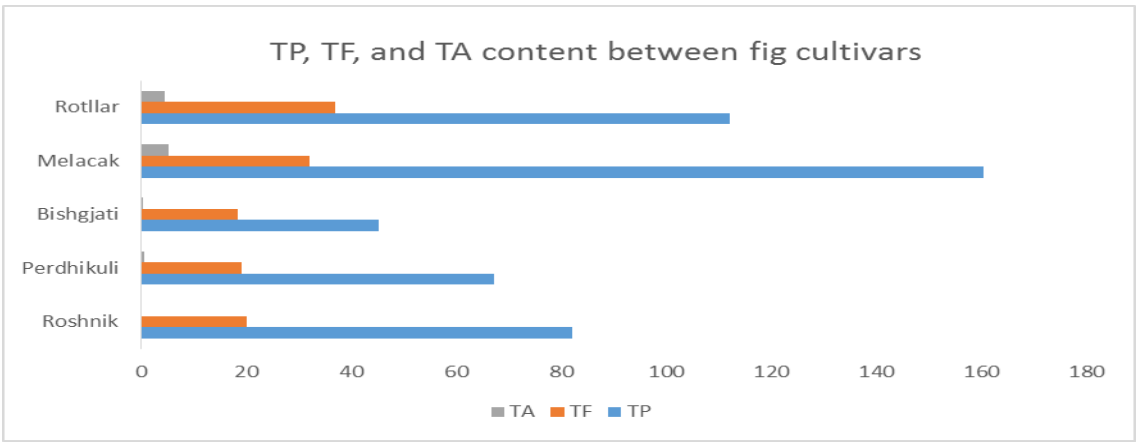

Figure 3: Total phenols, flavonoid and anthocianins content

This study in regard with other studies done before confirmed again suggesting that among all common fruits and vegetables in the diet, berries, and figs, especially those with dark blue or red colors, have the highest antioxidant capacity (Liu et al., 2002; Solomon et al., 2006; Celik et al., 2008).

CONCLUSION

Selected figs displayed variable TP, TAC, TF and TA profiles on fruits with different skin color from darker to lighter. This study demonstrated that sun-drying of fig fruit might result in an increased bio accessibility of TP content as well as TAC, nevertheless further studies is needed.

In recent years, however, because of the increasingly apparent importance of a healthy diet, the data obtained maybe useful for researchers also to include phytochemical analysis in germplasm evaluation, or for the breeding programs.

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