STORAGE INFLUENCE ON THE ANTIOXIDANT ACTIVITY OF DIFFERENT PLUM CULTIVARS

INFLUENȚA PĂSTRĂRII ASUPRA ACTIVITĂȚII ANTIOXIDANTE A DIFERITE SOIURI DE PRUNE

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Abstract. *The antioxidant properties of different plum cultivars during storage were studied.Total phenolics and total anthocyanins content were also determinated.Total phenolics ranged from 60.54 mg/100g GAE (BN68) to 364.21 mg/100g GAE (Record)in the case of fresh samples and from 128.67 mg/100g GAE (BN68) to 563.88 (Blue free) in the case of samples kept at 4°C during 10 days. The antioxidant activity of the samples was evaluated through several biochemical assays: DPPH (2.2-diphenyl-1-picrylhydrazyl) radical scavenging activity, ORAC (oxygen radical absorbance capacity). The plum cultivars with high antioxidant potential are Carpatin, Stanley, Blue free and Joris plum. There were obtained good correlation among the antioxidant activities measured by ORAC and DPPH, suggesting that these methods have similar predictive capacity for antioxidant activities of plum samples. Antioxidant activity varied greatly among the plum cultivars used in this study and during the storage.*
Keywords: plum antioxidant activity, phenolics, DPPH.

Rezumat. *In această lucrare au fost determinate proprietățile antioxidante ale diferite soiuri de prune în timpul păstrării la 4°C timp de 10 zile. Conținutul de compuşi fenolici totali şi conținutul de antociani a fost de asemenea determinat. Conținutul de compuşi fenolici totali a variat de la 60.54 mg/100g GAE (BN68) la 364.21 mg/100g GAE (Record) în cazul prunelor proaspete şi de la 128.67 mg/100g GAE (BN68) la 563.88 (Blue free) în cazul prunelor păstrate la 4°C timp de 10 zile. Activitatea antioxidantă a probelor de prune a fost evaluată cu ajutorul următoarelor metode: DPPH (radical liber 1,1 difenil - 2- picrilhidrazil) şi ORAC (capacitatea de absorbție a radicalilor de oxigen). Printre soiurile de prune cu un potențial antioxidant ridicat s-au numărat: Carpatin, Stanley, Blue free and Joris plum. S-au obținut corelații bune între activitatea antioxidantă determinată cu DPPH şi ORAC, fapt care sugerează că cele două metode folosite au o capacitate de predicție similară în cazul activității antioxidante a prunelor. S-a înregistrat o mare variabilitate a soiurilor studiate în ceea ce priveşte activitatea antioxidantă pe perioada păstrării.*
Cuvinte cheie: activitatea antioxidantă a prunelor, fenoli, DPPH.

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INTRODUCTION

Fruit have long been promoted for their health benefits in preventing various cancers and age-related diseases (Prior and Cao, 2000; Wargovich, 2000). In the recent years antioxidant activity and the content of total phenolic compounds of several plum cultivars have been investigated in order to suggest plum varieties rich in antioxidants, which may possibly exert beneficial effects on human health. (Janja et. al., 2011)

Plums demonstrated very good scavenger activity against oxygen-derived free radicals such as hydroxyl and peroxyl radicals (Murcia et al., 2001). Plums contain copious amounts of natural phenolic phytochemicals, such as flavonoids and phenolic acids, which may function as effective natural antioxidants in our daily diet. Wang, Cao, and Prior (1996) demonstrated that plums had 4.4 times higher total antioxidant capacities than apples, the latter being one of the most commonly consumed fruits in our diet.

Plums are an important common stone fruit in Romania. No literature on the changes occurring in the bioactive compounds during storage of plum is available. The main objective of our study it was to investigate the antioxidant potential of different plum cultivars during storage. The changes of bioactive compounds like phenols and anthocyanins were also evaluated.

MATERIAL AND METHOD

Twelve plum cultivars (Carpatin, Silvia, BN7 237-7, Tuleu gras, Superb, Dâmbovița, D'agen, Stanley, Record, Blue free, Joris plum, BN68) were picked at commercial maturity from Research Station Miroslava, Iasi. The samples were split in two series after they was washed and after stone removal, first series was used for the determination of the antiradical potential and phenolic and anthocyanins content, the second series was kept at 4 °C during 10 days.

For the extract, 1 g of the plum was grounded with 10 mL of extraction solvent: acetone (70%), water (28%), acetic acid (2%) (Counet, 2003). The mixture was shaken for 1 h at 4 °C and centrifuged at 17000*g* for 15 min. The supernatant was removed, and the pellet was extracted again with 10 mL of the same solvent, incubated for 15 min, and centrifuged using the same procedure. The extract obtained was kept at -30°C until analyses. Each sample was independently extracted in triplicate.

Total phenolic contents were determined according to the Folin–Ciocalteu method (Caboni, 1997). Appropriately diluted extracts (3.6 mL) were mixed with 0.2 mL of Folin–Ciocalteu reagent, and 3 min later, 0.8 mL of sodium carbonate (20% w/v) was added. The mixture was heated at 30 °C for 1 hour. After cooling, the absorbance at 750 nm was measured. Gallic acid (Sigma) was used as standard, and results were expressed as milligrams of Gallic acid equivalents (GAE) per 100 g of sample. Analyses were performed in duplicate on each sample.

Antioxidant capacity was determined by scavenging of the radical 2,2-diphenyl-1-picrylhydrazyl (DPPH) as described by Tadolini et al. (2000). Trolox was used as a standard and methanol as a blank. The absorbance at 517 nm using an Uvikon 931 spectrophotometer (BIOTEK Instruments) of samples, standards, and blanks was determined after 5 min. The results were expressed as micromolar Trolox equivalents (TE) per 100 g of sample. Analyses were performed in duplicate.

ORAC assays were carried out on a Victor 3 (PerkinElmer) at 37°C. Procedures were based on the method of Wu, Gu, Prior, and McKay (2004). Procedures were based on the method of Wu et al. (2004). Briefly, AAPH was used as peroxyl radical generator, Trolox as standard, and fluorescein as fluorescent probe. Fluorescence filters were used for an excitation wavelength of 485 nm and an emission wavelength of 520 nm. 25 of diluted sample, blank, or Trolox calibration solutions were mixed with 150 μL of 4 μM fluorescein and incubated for 15 min at 37°C before injection of 25 μL of AAPH solution. All samples were analyzed in duplicate at three different dilutions. The final ORAC values were calculated using the net area under the decay curves and were expressed as micromolar Trolox equivalents (TE) per 100 g of sample.

Anthocyanin quantification was performed by the pH-differential method (Guisti, et al., 2001). The extract was diluted in a pH 1.0 solution (0.1 M HCl, 25 mM KCl) and in a pH 4.5 solution (0.4 M CH_3COONa). The absorbance of the mixtures was then measured at 534 and 700 nm against distilled water. The value (Abs535 – Abs700) pH1.0 – (Abs535 – Abs700) pH4.5 corresponds to the absorbance due to the anthocyanins. Results were expressed as milligrams of cyanidin 3-glucoside equivalents per 100 g of sample.

Descriptive statistical analysis was performed using Microsoft Excel. Results were expressed as mean values ± standard error. Differences was considered statistically significant at the level of $p < 0.05$.

RESULTS AND DISCUSSIONS

Fruits and vegetables have been receiving increased interest from consumers and researchers for their beneficial health effects on human diseases, mainly due to their antioxidant activity (Danesi and Bordoni, 2008).

There are many assays used for determination of antioxidant activity of fruits and vegetables. We evaluate the antioxidant activity of plum cultivars with two very used *in vitro* methods ORAC and DPPH. ORAC assay measures the reaction between antioxidants and the peroxyl radicalas (Patthamakanokporn et. al., 2008).

Figure 1 present the results for antioxidant activity determined by ORAC assay. Among fresh plum fruits, Blue free had the highest antioxidant activity (3444 ± 381 µmole TE/100 g fresh sample) and was followed by Joris plum (2975 ± 271 µmole TE/100 g fresh weight) and Record (2865 ± 67 µmole TE/100 g fresh weight). BN7-237-7 and Silvia cultivars presented the lowest antioxidant activity (1371 ± 142 µmole TE/100 g fresh weight and 1181 ± 101 µmole TE/100 g fresh weights, respectively).

There are significant differences between fresh samples and those kept at 4°C during 10 days for the following plum cultivars: Carpatin, Superb, Record, Joris plum, Tuleu gras, Dâmbovița, Stanley, Blue free, BN68. The samples refrigerated, Carpatin, Stanley, Blue free, Joris plum, Silvia and BN68 increased their antioxidant potential during storage.

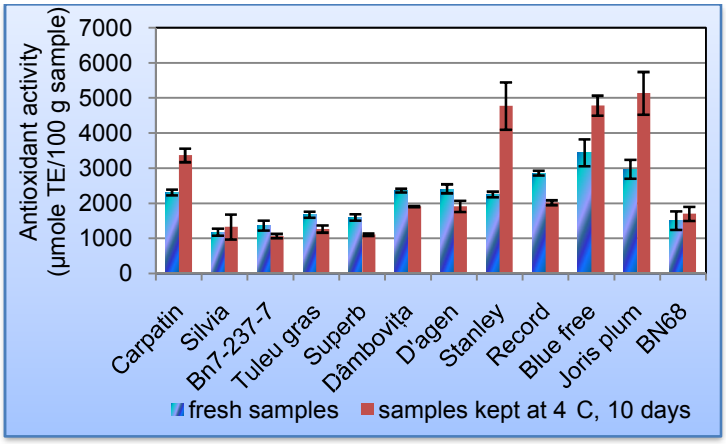

Fig. 1 - Antioxidant activity of plums, measured by ORAC assay.

The antiradical potential measured by DPPH method (fig. 2), was higher in Carpatin, fresh samples (730 µmole TE/100 g fresh weights), Record (554 µmole TE/100 g fresh weight) and Superb (468µmole TE/100 g fresh weight).

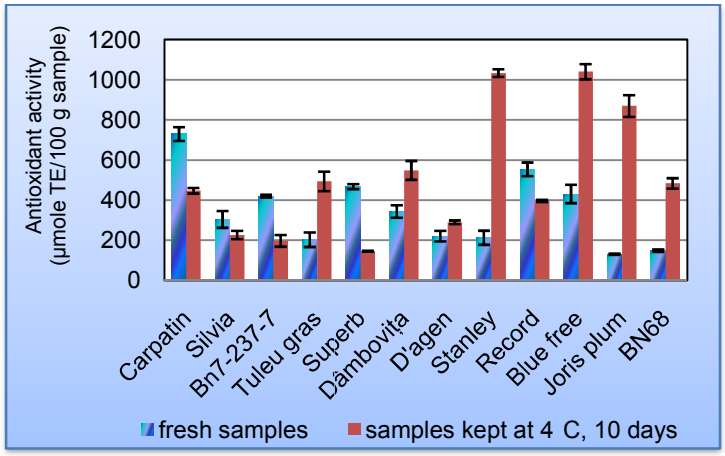

Fig. 2 - Antioxidant activity of plums, measured by DPPH method

For antioxidant activity, we can observed that Blue free surprisingly increased the antioxidant potential almost three times during storage and Stanley increased by almost five times, results obtained by ORAC assays. Excepting D'agen and Silvia, all plum cultivars showed significant differences between fresh and refrigerated samples.

Total phenolic content (fig. 3) of the fresh plum ranged from 60.5 mg GAE/100g fresh weight (BN68) to 364 mg GAE/100g fresh weight (Record). In the case of refrigerated samples (4 ºC, 10 days), total phenolic content ranged from 129 ± 3 mg GAE/100g sample weight (BN68) to 564 ± 33 mg GAE/100g sample weight (Blue free).

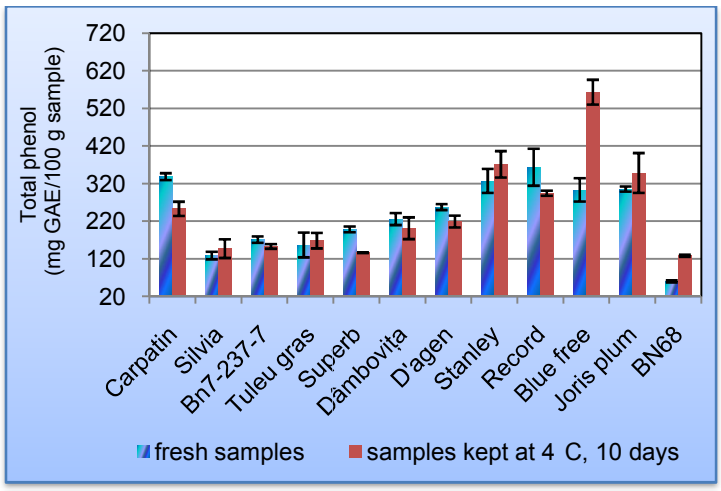

Fig. 3 - Total phenolic compounds of the samples.

For anthocyanins content, we can observe that Tuleu gras and BN7-237-7 (45.3 ±0.8 and 49.1 ± 5.7 mg CE/100 g fresh weight, respectively) cultivar presented the smallest value of anthocyanins in the case of fresh samples (fig.4).

The biggest anthocyanin content was registered by the Carpatin cultivar, both fresh and stored sample (145 ± 17 and 144 ± 31 mg CE/100 g sample weight, respectively). BN68 (53.2 ± 2.0 mg CE/100 g sample weight) showed the smallest anthocyanins content for the refrigerated samples. Most of plum cultivars increased their anthocyanins content during storage, except Carpatin, Silvia and Record.

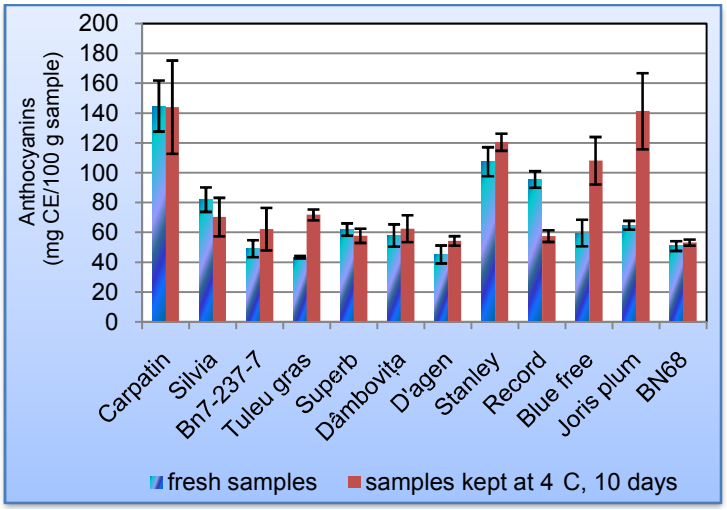

Fig. 4 - Anthocyanins content of the plum cultivars

CONCLUSIONS

1. The results obtained suggest that plums, even after a storage period of 10 days at 4 °C, could be a good source of antioxidants, which may provide health-promoting effects for humans.

2. Stanley, Blue free and Joris plum are the plum cultivars that increased their antioxidant activity during storage, in the case of both methods used, ORAC and DPPH.

3. Carpatin and Stanley seems to have the richest anthocyanins content from all the plum cultivars analyzed.

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