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Evaluation of buckwheat sprouts as microgreens

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ABSTRACT

Microgreens from common and tartary buckwheat genotypes were evaluated for total flavonoid content (rutin, quercetine and kaempferol separately), bound phenolic acids content, carotenoids and α-tocopherol content and antioxidant activity. The results have shown that in common and tartary buckwheat microgreens antioxidant activity was found. High level of flavonoids, carotenoids, and α-tocopherol was detected as well. Higher amount of flavonoids was found out in tartary buckwheat microgreens. No significant differences were detected between common and tartary buckwheat microgreens in content of phenolic acids. Microgreens of both common and tartary buckwheat represent potential nutritional sources for alternative vegetable in the Czech Republic.

Key words: buckwheat, microgreens, flavonoids, rutin, phenolic acids, carotenoids, antioxidant activity

IZVLEČEK

PREHRANSKE LASTNOSTI MLADIH RASTLIN AJDE

Vsebnost celokupnih flavonoidov (posebej rutina, kvercetina in kempferola), vezanih fenolnih kislin, karotenoidov, α-tokoferola in antioksidantna aktivnost so bili raziskani pri mladih rastlinah navadne in tatarske ajde. Ugotovljena je antioksidativna aktivnost izvlečkov mladih rastlin navadne in tatarske ajde ter visoka vsebnost flavonoidov, karotenoidov in α-tokoferola. Posebej visoka vsebnost flavonoidov je bila ugotovljena pri tatarski ajdi, medtem ko glede na vsebnost fenolnih snovi ni bilo razlike med mladimi rastlinami navadne in tatarske ajde. Mlade rastline tako navadne kot tatarske ajde so možen alternativni vir zelenjave v Češki republiki

Ključne besede: ajda, mlade rastline, flavonoidi, fenolne kisline, karotenoidi, antioksidativna aktivnost

1 INTRODUCTION

Antioxidants help organisms to deal with oxidative stress, caused by free radical damage. Free radicals are chemical elements, which contains one or more unpaired electrons due to which they are highly unstable and cause damage to other molecules by extracting electrons from them in order to attain stability (Ali *et al.,* 2008). Some of these molecules can be physiologically useful, but they can also cause damage under certain circumstances. The most notorious among these damages being neurodegenerative conditions like Alzheimer's and Parkinson's disease. Other neurodegenerative diseases significantly associated with oxidative stress include multiple sclerosis, Creutzfeldt–Jacob disease, and meningoencephalitis (Darley-Usmar and Halliwell, 1996; Ali *et al.,* 2008). Reparative processes of organism are not sufficient enough to eliminate all damages in organism caused by free radicals. One of the possibilities how protect organism against free radicals is supplement of antioxidants. The main sources of antioxidants in the human nutrition are fruits and vegetables (Traka and Mithen, 2009).

Microgreens are very specific type of vegetable. They are very similar to sprouts but grow several days longer making them larger leaved, and greener, they are the crop being grown hydroponically and organically. Microgreens are considered to be in the group of what are newly referred to as "functional foods" which are food products that possess particular health promoting or disease preventing properties that are additional to their normal nutritional values. Demand for these products is growing rapidly. Microgreens have been found to contain higher levels of concentrated active compounds than found in mature plants or seeds.

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Microgreens are filled with vitamins, minerals, and antioxidants (MicroGreensUSA, 2009; Brentlinger, 2007). Common microgreens are grown mainly from cabbage, beet, kale, kohlrabi, mizuna, mustard, radish, Swiss chard, and amaranth.

Common buckwheat is traditional crop in the Czech Republic territory. It is very important for low-input agricultural system where it is one of most often growing crops (Michalová, 2003). Tartary buckwheat is not traditional in the Czech Republic, but in the last few years, there has been a demand for this crop, mainly as a medicinal plant, because of its high content of rutin and other polyphenols and suitability for the production of nutraceutical products and functional foods (Michalová, 2000).

The aim of this study was to evaluate common and tartary buckwheat as microgreens and to compare flavonoids, carotenoids, and selected phenolic acids content.

2 MATERIALS AND METHODS

Plant materials and growth conditions

The common and tartary buckwheat genotypes were obtained from the buckwheat collection of the Czech Gene Bank, CRI and from Institute of Biotechnology, Shanxi University, Taiyuan, China. The passport data about the samples origin are listed in Table 1.

Table 1 Passport data about the buckwheat samples

No.	ECN*	Name of variety	Origin
	common buckwheat (Fagopyrum esculentum)		
1	01Z5000072	Sudtirol Nr. 3	unknown
2	01Z5000123	Kara-Dag	Ukraine
3	01Z5000127	Jana	Ukraine
	tartary buckwheat (Fagopyrum tataricum)		
4	01Z5100001	unnamed	Bhutan
5	01Z5100010	Lifago	Germany
6		Jianzui	China
7		Liu	China
8		Jiujing	China

*National accession number

Common and tartary buckwheat seeds were soaked with distilled water for 24 h and shaken frequently. After that time, seeds were rinsed by running distilled water. Then they were put into holes of germination equipment and grown hydroponically. Microgreens were grown at daylight for 10 days until the first true leaves appeared. Plants were washed every day by distilled water. After cultivation, all samples were frozen in -25°C and then lyophilized and milled for later extraction.

Determination of DPPH activity

Free radical scavenging capacity was evaluated according to the previously reported procedure using the stable DPPH radical according to Şensoy et al. (2006). This method measures radical scavenging capacity and results are expressed as gallic acid equivalents per g of dry matter (mg $GAE.g^{-1}$ dm). Antioxidant activities were determined by reacting 1 mL of methanolic extract of grains with 100 µL 200 µM DPPH. Absorbance of the samples at 515 nm was measured after 4 min reaction at room temperature in dark.

Determination of total flavonoids, bound phenolic acids and carotenoids

Total flavonoids were analysed spectrophotometrically after 1 hour extraction in mixture methanol: H_2O: acetic acid (100:100:2) using non-specific reaction with $AlCl_3$ and expressed as equivalents of rutin according to Van Hung et al. (2008). Three flavonoids – rutin, quercetine, and kaempferol were analyzed by HPLC method with UV detection according to Kreft et al. (2006) slightly modified. Comparing of retention time in sample and analytical standard was used for compound identification. Flavonoids were quantified using external calibration.

Bound phenolic acids were determined using HPLC with UV detection after the alkaline hydrolyzation according to Kim et al. (2006). Selected cinnamic acid derivatives (caffeic, p-coumaric, and ferulic acid) and benzoic acid derivatives (vanillic and syringic) were monitored at 320 and 280 nm, respectively. Carotenoids were extracted with water-saturated butanol according to Hidalgo et al. (2006) and chromatographic separation was performed on C18 stationary phase with mixture of methanol, acetonitrile, and dichloromethane as mobile phase and spectrophotometric detection using in house method. Identification and quantification of all compounds was performed using external analytical standards.

3 RESULTS AND DISCUSSION

DPPH activity

The DPPH activity (Fig. 1) depended on species and genotypes. Microgreens of both species possessed higher antioxidant activity than seeds. Microgreens of tartary buckwheat showed higher antioxidant activity than those of common buckwheat, contrary to Kim *et al.* (2008); they published similar results of antioxidant activity in common and tartary buckwheat sprouts grown for 10 days. Only common buckwheat genotype ´Sudtirol 3´ had higher activity than genotype ´01Z5100001´of tartary buckwheat. The tartary buckwheat varieties 'Jianzui' and ´Liu´ originated in China showed the highest antioxidant activity.

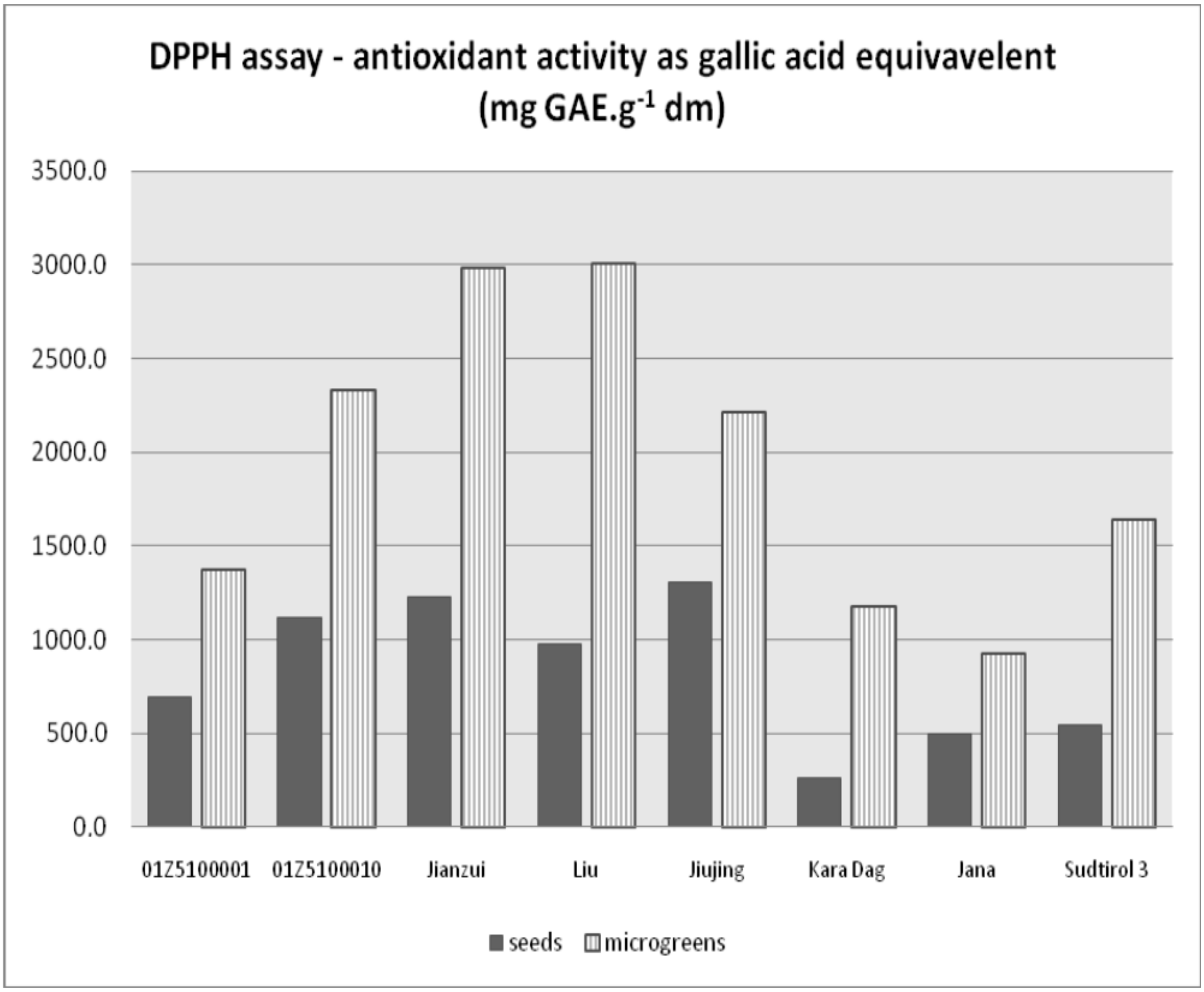

Fig. 1. DPPH assay of common and tartary buckwheat microgreens

Total flavonoids, phenolic acids and carotenoids

The quantities of phenolics such as flavonoids (including rutin, kaemferol, and quercetine), and phenolic acids (such as cinnamic acid derivatives caffeic, p-coumaric and ferulic acid and benzoic acid derivatives vanillic and syringic) and α-tocopherol in microgreens from common and tartary buckwheat are shown in Fig. 2 and Fig. 3 respectively. The higher content of flavonoids was in tartary buckwheat microgreens. It corresponds with results of many authors; they published comparison of flavonoids content in seeds of tartary and common buckwheat (Fabjan *et al.,* 2003; Kim *et al.*, 2008). The main flavonoid in common and tartary buckwheat is rutin as published Liu *et al.* (2008). . Its higher content was detected in tartary buckwheat microgreens, which corresponded with Kim *et al.* (2008) who determined higher rutin content in tartary buckwheat sprouts.

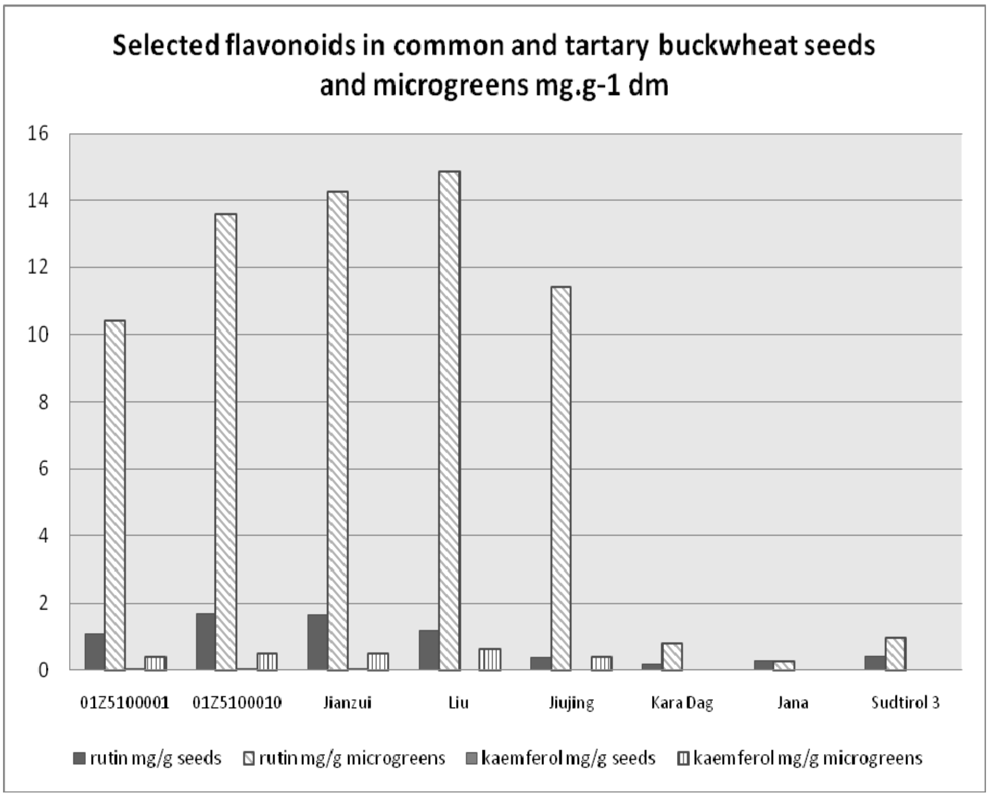

Fig. 2. Flavonoids in common and tartary buckwheat seeds and microgreens

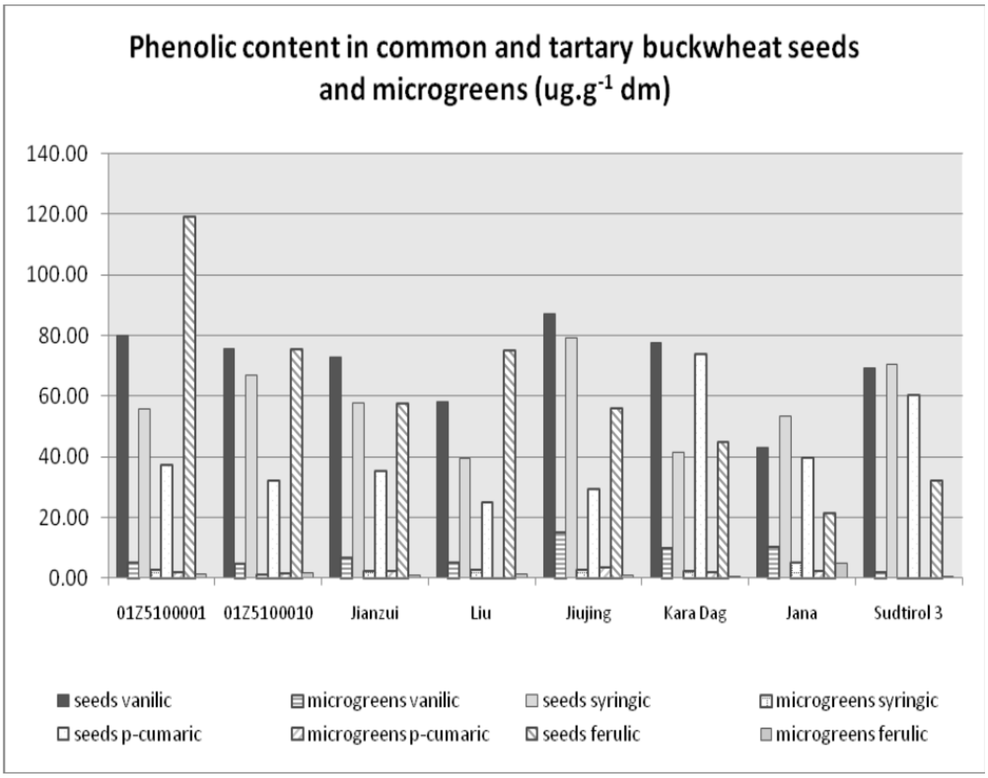

Fig. 3. Selected phenolic acids in common and tartary buckwheat seeds and microgreens

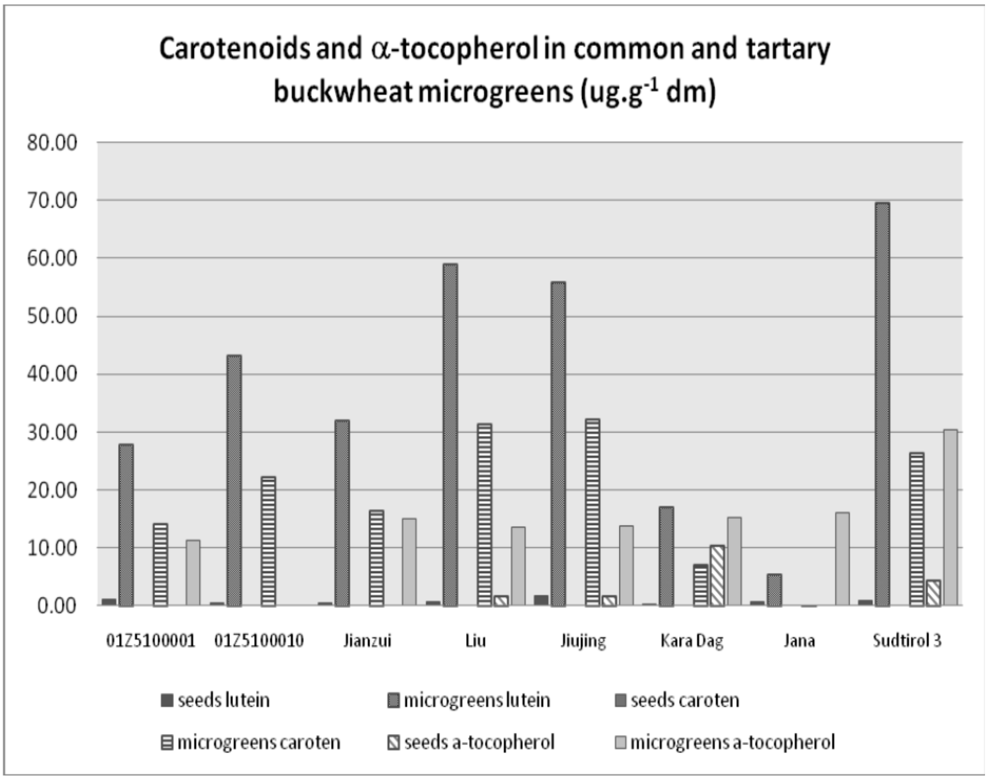

Fig.4. Selected carotenoids and α-tocopherol in common and tartary buckwheat seeds and microgreens

No significant differences were detected in content of phenolic acids between common and tartary genotypes. On the other hand, the differences between seeds and microgreens in phenolic acids content were statistically significant. Generally, the amount of phenolic acids was higher in seeds than in microgreens of both species. Similar results published Alvarez-Jubete *et al.* (2010) in common buckwheat seeds and sprouts. In case of vanillic acid in microgreens, the highest amount was detected in tartary buckwheat genotype ´Jiujing´ and the second highest level in common buckwheat variety ´Jana´. The caffeic acid was determined only in common buckwheat genotype ´Sudtirol 3´. Contrary to phenolic acids content, there was higher content of carotenoids and α-tocopherol in microgreens than in seeds of both species. Caroten was under quantification level in seeds, which was 0.3 $ug.g^{-1}$ dm. . In microgreens of ´Jiujing´ genotype, the caroten level was more than 100times higher than in seeds Very similar results were obtained in the case of lutein and α-tocopherol content in all genotypes. The highest content of lutein and α-tocopherol was determined in microgreens of genotype ´Sudtirol 3´.

4 CONCLUSION

Our results have shown that antioxidant activity was found both in common and tartary buckwheat microgreens. High levels of flavonoids, carotenoids, and α-tocopherol were detected as well. Higher amount of flavonoids was detected in tartary buckwheat microgreens. No significant differences were detected between common and tartary buckwheat microgreens in content of phenolic acids. Microgreens of both common and tartary buckwheat represent potential nutritional sources of alternative vegetable in the Czech Republic.

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