Functional compounds of einkorn and emmer genotypes

Antioxidants and trace elements

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Summary: Three einkorn and two emmer genotypes were analysed for concentration of microelements (Fe, Zn and Se) and lipid soluble antioxidants (α-tocopherol, α-tocotrienol and β-carotene). A diversity was observed in micronutrient content, but most of the genotypes have significantly higher trace element and antioxidant contents than the control wheat variety. The emmer genotypes contain lower Fe and β-carotene concentration than einkorn genotypes. The einkorn genotypes have significant higher antioxidant content than the wheat control. On average einkorn has more than three times more β-carotene than the wheat variety. Our results are useful for variety choice in organic food production.

Background

Einkorn (*Triticum monococcum* L.) and emmer (*Triticum turgidum* L. subsp. *dicoccum*) are hulled wheat, their domestication began more than 10 000 years ago and they were staple crops for millennia. The production of einkorn and emmer were replaced with naked species and now they are minor crops, cultivated mainly in limited and marginal regions for producing traditional foods and products and for animal feed (Perrino 1996).

Their main value lies in yield stability and resistance to fungal diseases. Hulled wheats are becoming more important crops of the expanding organic agriculture. On the basis of their agronomic and resistance characteristics, einkorn and emmer are ideal low-input crops.

Introduction

Cereals are important sources of micronutrient minerals and antioxidants. The most important microelements for human nutrition are Fe, Zn and Se (Zhao et al. 2009). Among the numerous antioxidant compounds present in foods lipid soluble antioxidants (tocols and carotenoids) play an important role in disease prevention (Halliwelll et al. 1995). The main objective of the present study was to investigate the variation in the micronutrient content. Modern plant breeding has been historically oriented towards high agronomic yield rather than the nutritional quality. Increased grain yield may have resulted in a lower density of certain minerals (Zn) in grain (Zhao et al. 2009). In bread wheat, however, the concentration of carotenoids and tocols is low, but they are more abundant in hulled wheat. Emmer and einkorn are also an excellent source of several other functional compounds (Hidalgo et al. 2006, Zaharieva et al. 2010), and are very useful in organic farming practice.

Materials and methods

Three einkorn (*Triticum monococcum* L.) and two emmer (*Triticum turgidum* L. subsp. *dicoccum*) genotypes were selected for analysing their trace element (Fe, Zn, Se) and lipid soluble antioxidant (α-tocopherol, α-tocotrienol and β-carotene) content. All genotypes are organically bred varieties and breeding lines. The control was a conventional bred Martonvásár winter wheat variety (Table 1). The different genotypes were cropped during the 2011/2012 growing season at Martonvásár (Hungary).

The trace element determination measurement was carried out by Varian SpectrAA-50/55 instrument. Determination of tocols was carried out by HPLC experiments using Shimadzu LCMS-2010EV instrument coupled with fluorescence detector (RF-20A). Determination of β-carotene was carried out using Shimadzu HPLC system coupled with diode array detector (SPD-M20A). The trace element and antioxidant determinations were carried out by Eszterházy College.

Differences in trace element and antioxidant content were assessed by one-way ANOVA using Breeder Software.

Results

The concentration of trace elements and lipid soluble antioxidants were determined (Table 1).

Microelements

Differences in microelement content between the einkorn and emmer genotypes were observed. The einkorn genotypes have higher content of Fe, Zn and Se, than the control wheat genotype, except the Se content of Mv Alkor. The Fe contents of two einkorn genotypes (Mv Menket and Mv Alkor) were significantly higher than that of the control wheat variety. The Zn and Se contents of the emmers were higher than that of the wheat control, but their Fe content was similar to wheat.

Antioxidants

All einkorn genotypes showed higher content of tocols (α-tocopherol and α-tocotrienol) and β-carotene than the wheat control. On average einkorn had more than three times more β-carotene than the wheat variety and six times more than the average of tested emmer genotypes. The significantly high levels of fat soluble antioxidant content provides an evidence for that these einkorn varieties are nutritionally outstanding cereals, giving an excellent source for functional food production and for the production of natural antioxidants for the food industry.

The emmer genotypes had lower tocol content than the einkorn wheats but in the most cases their tocol content was significantly higher than that of the wheat control.

Table 1: Trace element (Fe, Zn, Se) and antioxidant (α-tocopherol, α-tocotrienol, β-carotene) content of einkorn and emmer genotypes, standard deviation (STD) in parentheses

Genotype	Species	Fe (mg/kg)	Zn (mg/kg)	Se (mg/kg)	α-tocopherol (mg/kg)	α-tocotrienol (mg/kg)	β-carotene (mg/kg)
MvA6-13	einkorn	29.59 (3.57)	55.06*** (1.55)	0.603** (0.057)	24.93*** (0.13)	5.48*** (0.30)	0.85*** (0.04)
Mv Alkor	einkorn	37.02*** (1.89)	66.91*** (2.81)	0.465 (0.061)	25.72*** (0.11)	8.96*** (0.02)	1.13*** (0.09)
Mv Menket	einkorn	38.08*** (0.85)	33.73 (7.11)	0.742*** (0.032)	20.84*** (0.15)	10.47*** (0.02)	1.04*** (0.05)
Mv Hegyes	emmer	24.44 (0.49)	63.41*** (9.25)	0.547 (0.063)	15.46*** (0.09)	2.35 (00.02)	0.17 (0.01)
MvE5-14	emmer	27.49 (0.64)	45.47** (3.57)	0.767*** (0.017)	19.00*** (0.09)	3.77*** (0.01)	0.15 (0.03)
Control	winter wheat	27.16 (0.65)	27.46 (3.88)	0.474 (0.024)	11.94 (0.10)	3.21 (0.04)	0.31 (0.05)

*** significant difference at P=0.1%; ** significant difference at P=1%

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