Comparison of functional food components in grain of high anthocyanin GM and non-GM rice

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Abstract

In the modern era, development of high-value functional foods with unique and novel elements is becoming an important prospect for the food industry. Some compounds are known to confer protection against oxidative damage caused by free radicals and thus may play a significant role in preventing diseases such as cancer, and cardiovascular and neurological disease. In this study, high anthocyanin GM and non-GM rice were compared for DPPH (1, 1-diphenyl-2-picrylhydrazyl) free radical scavenging activity, total polyphenol, tocopherol, phytosterol and octacosanol contents. The free radical scavenging and total phenolics were higher in GM rice than non GM rice cultivar. Nonetheless, there was no difference between cultivars in fatty acid, octacosanol, totopherol or totol phytosterol contents.

Keywords

Functional elements, Anthocyanin, Rice, GM, Antioxidant activity

Introduction

The anthocyanins display anti-inflammatory activity and have been found to suppress weakening of capillary vessels (Lee et al. 2003). In this regard, pigmented rice, owing to high anthocyanin content, is of special consideration and has high demand because of its anti-oxidant properties (Oikawa et al. 2008). In addition, as natural soluble pigments, anthocyanins may have some commercial value for the food industry (Shen et al. 2009).

Several groups are working to identify and extract functional elements from plant sources. In this regard, development of transgenic plants that could produce useful materials on a large scale is a very attractive prospect. Use of genetically modified (GM) crops is increasing throughout the world. Nonetheless most of the GM crops being used are either meant for insect-pest/pathogen resistance or herbicide resistance. In this study high anthocyanin GM and non-GM rice were compared for DPPH (1, 1-diphenyl-2-picrylhydrazyl) free radical scavenging activity, total polyphenol, tocopherol, phytosterol and octacosanol contents using spectrometric and chromatographic methods.

Methodology

The high anthocyanin containing GM elite rice lines DKU 1-3, DKU 2-3, and a non-GM line, Heugjinjubyeo, were planted at the paddy field at Dankook University Farm, Republic of Korea in 2009. Antioxidant activities of grain extracts were measured by scavenging DPPH free radicals using spectrometric and chromatographic methods. DPPH methanol solution (150 µm) was added to the samples of different concentrations, and allowed to react at room temperature. After 30 min the absorbance was measured at 518 nm using a microplate reader. Total polyphenol contents were assayed by the Folin-Denis method with slight modification, as follows. Folin-Ciocalteu reagent (1N 50 µL) was added to 100 µL of each sample solution; there were 3 samples for each line. The reactant was neutralized with 50 µL saturated sodium carbonate(Na_2CO_3) for 3 min. After 30min the absorbance values were measured at 750 nm using a microplate reader. Total polyphenol contents was expressed as mg of gallic acid equivalent per 1g of dry weight. Contents of amylose, protein and fatty acids were analyzed by Near-infrared Grain Tester and gas chromatography, respectively. Lipophillic components including tocopherols, phytosterols and octacosanol were analyzed by gas chromatography.

Results

A standard chromatogram of tocopherol, phytosterols and octacosanol is presented in Fig. 1. Tocopherols and phytosterols contents were significantly higher in Heugjinjubyeo cultivar than lines DKU 1-3 and DKU 2-3 (Table 1). However, there was no difference between GM and non-GM rice cultivars for octacosanol contents.

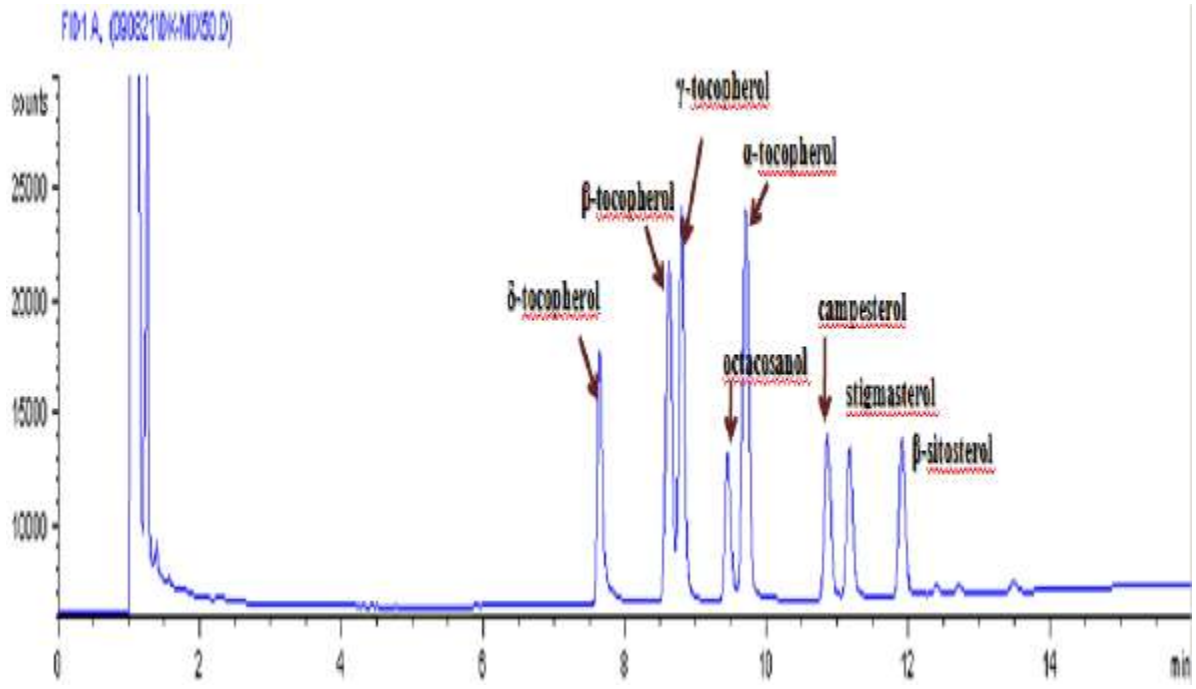

Fig. 1: GC chromatograms of tocopherol, phytosterols and octacosanol compound.

Table 1: Comparison of lipophillic components contents in GM and non-GM rice grain

Cultivars	Individual components of tocopherols				Total tocopherols	Octacosanol	Major components of phytosterols			Total Phytosterols
	α-T	β-T	γ-T	δ-T			Campesterol	Stigmasterol	β-sitosterol	
	(µg /100g)						(mg/100g)			
DKU 1-3	750	179	303	N.D.	1232 b	976 a	13.39	11.60	35.40	60.40 b
DKU 2-3	939	120	236	N.D.	1295 b	1029 a	12.36	11.23	39.58	63.17 b

Heugjinjubyeo	1006	274	376	N.D.	1656 a	990 a	17.17	16.04	40.87	74.07 a

Means followed by the same letter are not significantly different at the 5% level by DMRT.

Antioxidant activities and total phenol contents in DKU 1-3 and DKU 2-3 lines were higher than non-GM cultivar Heugjinjubyeo (Fig. 2).

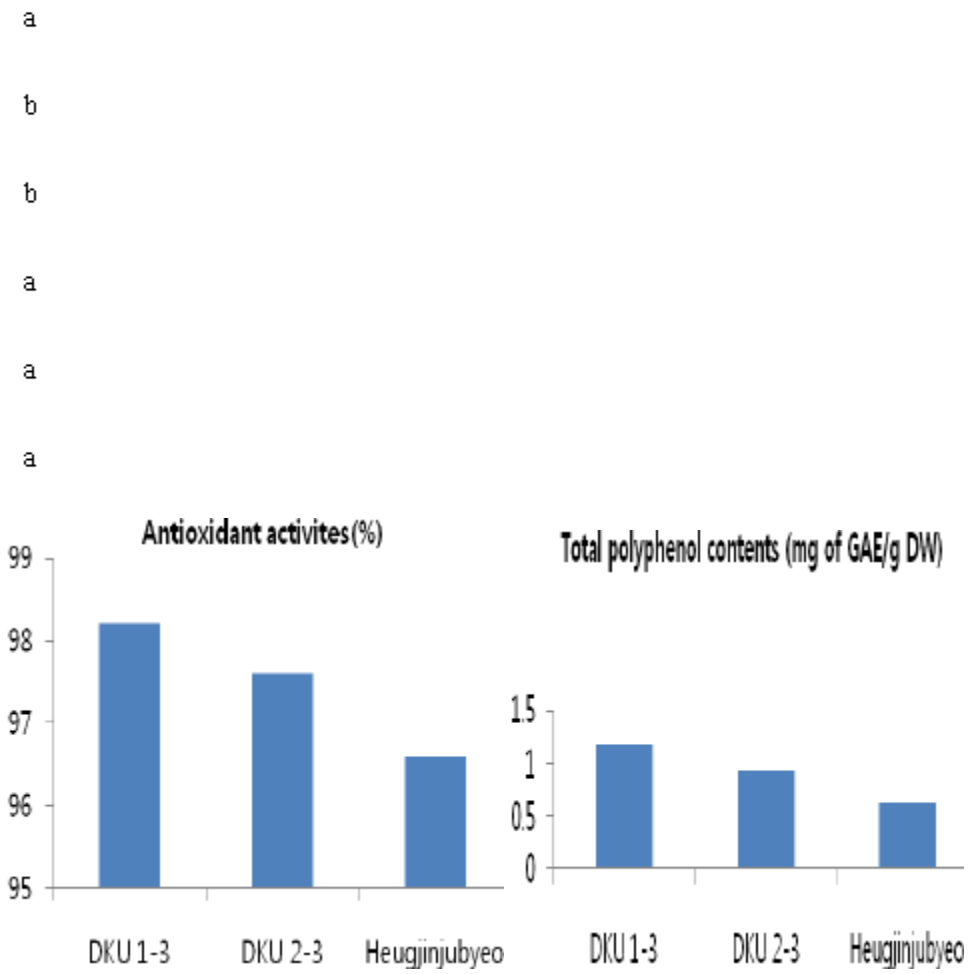

Fig. 2: Comparison of antioxidant activities and total polyphenols contents in GM and non-GM rice grains. Means followed by the same letter are not significantly different at the 5% level by DMRT.

Discussion and Conclusion

The phenolics act as antioxidants and protect biological systems from oxidative damage (Hu et al. 2003). In this study higher total phenolics and antioxidant activity was observed in GM elite rice lines DKU 1-3 and DKU 2-3, compared with the non-GM rice line Heugjinjubyeo (Fig. 2). Previously Shen et. al. (2009) also reported significant positive pair-wise correlations among the phenolics, flavonoid contents and antioxidant capacity. They also found strong correlation between the phenolics and antioxidant capacity. Although tocopherols and phytosterols contents were higher in non-GM rice than GM rice, there was no difference for octacosanol contents in both rice types (Table 1). Recent interest in anthocyanins as functional ingredients has been generated by their potential role in preventing chronic and degenerative diseases due to their antioxidant (Hu et al. 2003), anti-inflammatory (Hu et al. 2003), antiarteriosclerosis

(Xia et al. 2006), anticancer (Chen et al. 2006), hyperlipidemia (Guo et al. 2007), and hypoglycemic activities (Kwon et al. 2007). We conclude that high anthocyanin rice grains with higher antioxidant activity have significant potential as functional food materials.

Acknowledgements

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