Fruit Quality, Antioxidant Capacity and Nutrients between Organic and Conventional kiwifruit in Korea

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Key words: organic, kiwifruit, fruit quality, antioxidative capacity, nutrient

Abstract

Organic kiwifruits were smaller fruit size but had higher magnesium and dry matter content than conventional, meanwhile, fruit soluble solid content was similar to conventional. There were no significant difference in polyphenol contents and antioxidative capacity between organic and conventional although there were considerable variations among sample orchards. Several minerals were also similar levels in both systems.

Introduction

Korean kiwifruits are produced in southern coastal area between N33° to 35° and E126° to 128° such as Jeonnam, Gyeongnam and Jeju. These areas have enough rainfalls (annually 1,300 to 1,500mm) for kiwifruit growth and the temperature is suitable (annual avg. 13 to 14℃, winter temp. 0-2℃ in January). Major soil types are loam or sandy loam in these areas. Generally, the organic cultural practices are clearly different from conventional (Cook *et al.* 2004). Besides basic organic practices such as no biocides and synthetic fertilizers in organic kiwifruit production, Korean organic kiwifruit growers do not use commercial growth promoters for better fruit size as conventional growers do and they tend to apply more organic compost and plant extracts formulas from wild herbs during growing season (unpublished farm survey data, 2010). Meanwhile, the quality of agricultural produces from the different production systems can be influenced by the farming system *(Bordeleau et al.* 2002). It is still arguable but significant number of data support that organically produced fruits and vegetables were higher in nutrients such as minerals as well as dry matter content (Woese *et al.* 1997, Heaton 2001, Bordeleau *et al.* 2002). Secondary nutrients ('phytonutrient'), involved in plant immune system (Bordeleau *et al.* 2002), were also higher in organically grown vegetables (Brandt and Molgaard 2001). These nutrients are being closely related to the consumers' choice (Heaton 2001). This study was

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performed to compare the fruit quality of kiwifruits from organic and conventional production system.

Materials and methods

5 commercial organic kiwifruit (*Actinidia deliciosa* cv.'Hayward') orchards were chosen in Jeonnam and Gyeongnam province. These orchards have been fully grown and managed organically at least for 5 years up to 20 years after conversion and kiwifruit vines were 20 to 32 years old. Equally, 5 neighboring conventional orchards with the same cultivar at similar age were chosen nearby the organic orchard with similar cultural environment and practices except organic practices. Kiwifruits were sampled randomly from 10 different vines in the central part of each orchard in early November when the fruit soluble solid content reached 7°Bx. For fruit characteristics such as fruit weight, dry matter content, soluble solid content and fruit firmness, each 60 fruits from 5 different orchards were investigated right after harvest. For fruit oxidative capacity and other functional characteristic, each 3 to 5 fruits from 5 different orchards were taken to analyze. Total phenol compound was determined with 'Folin-Ciocalteu reagent according to Ferraris *et al.* (Ferraris *et al.* 1987). Electron donating ability (%) in fruit measured with reducing ability of the samples to 1,1, diphenyl-2-picryl hydrazyl (DPPH). Ethanol and water were used as solvent for sample extractions. 1 ml of 1.5 x 10-4M DPPH solution was added into 4ml of extracted aqueous, and the mixed solutions were shaken for 30 minutes at room temperature before the absorbance was measured at 520nm (Yamaguchi *et al.* 1999). The electron donating ability (%) was determined as 100 of electron donating ability–{(absorbance with the aqueous/absorbance without the aqueous) x 100}. Carbohydrate was analyzed by 'Anthrone methods' as described by Trevelyan & Harrison (Trevelyan and Harrison 1952) by dissolving 0-2 g. of anthrone in 100 ml of H_2SO_4, made by adding 500 ml of conc. acid to 200 ml of water. Integral Antioxidant Capacity (IAC) was measured by photochemiluminescence (Besco *et al.* 2007).

Results and Discussions

Fruit size did not differ between organic and conventional kiwifruit (Tab. 1). Soluble solid content and fruit hardness did not make any difference between both systems. However, the dry matter content of organic kiwifruit was higher than conventional. When this result was compared with the previous study in the US (Hasey *et al.* 1995), the soluble solid content showed similar result but the fruit firmness of organic kiwifruit of the previous study was better unlikely this study. These results are similar to the case with apple ('Golden delicious')(Bordeleau *et al.* 2002). Nonetheless, higher dry matter content of organic kiwifruits is considered very meaningful in terms of overall favour because higher dry matter content of kiwifruit is highly linked to better consumers' taste (Burdon *et al.* 2004).

Tab. 1: Fruit weight, soluble solids, dry matter and hardness of organic and conventional kiwifruit

Farming system	Fruit weight (g)	Soluble solid content (°Bx)	Dry matter content (%)	Fruit firmness (kg/5Ømm)
Organic	84.0±3.3	10.0±0.96	17.2±0.40	3.9±0.2

Conventional	90.3±6.4	9.3±6.4	16.2±0.59	4.1±0.3
	n.s	n.s	*	n.s

*Significant for P<0.05, n.s: none significant. Mean±standard error.

The content of total polyphenols, known for its antioxidative role, was not significantly higher in organic kiwifruit than conventional in both flesh and skin (Tab. 2). The oxygen radical absorbance capacity was also similar in both organic and conventional kiwifruit analyzed by using 2 solvents (water and ethanol) (Tab. 2). Although no significant differences were found in the functionality of organic kiwifruit in this study more samples and controlled environments could bring the difference between organic and conventional kiwifruit as avg. organic fruits were showing the higher tendency of polyphenols and oxygen radical absorbance capacity (ORAC).

Tab. 2: Content of polyphenols and oxygen radical absorbance capacity (ORAC) between organic and conventional kiwifruit

Farming system	Total polyphenols (mg/100g)		ORAC (%)	
	Flesh	Skin	Water	Ethanol
Organic	2.4±0.99	16.3±3.18	41.3±6.08	63.2±8.33
Conventional	2.3±0.51	14.4±2.18	34.7±8.66	62.1±7.18
	n.s[z]	n.s	n.s	n.s

[z]n.s: none significant. Mean±standard deviation

Tab. 3: Nutrients content between organic and conventional kiwifruit (mg/100g)

Farming system	Ca	Mg	K	Zn	Na	B
Organic	162.2±14.1	106.9±3.7	168.7±16.6	3.0±0.22	55.9±4.17	2.9±0.20
Conventional	155.4±11.3	94.7±3.7	156.7±11.9	3.1±0.33	64.1±3.77	2.8±0.22
	n.s	*	n.s	n.s	n.s	n.s

*Significant for P<0.05 , n.s: none significant. Mean±standard deviation

From the analysis on mineral content of organic and conventional kiwifruit, only magnesium content of organic kiwifruits was significantly higher than conventional and other minerals were similar to conventional (Tab. 3). This could be related to more compost and plant extract application in organic orchards because the soil analysis on the whole orchards of this study have shown higher soil magnesium content in organic orchards although the data was not different significantly (organic *vs.* conventional : 4.20 *vs.* 3.46 $cmol^+/kg$, unpublished data, 2010).

Conclusions

Although Korean organic kiwifruits showed similar fruit size, soluble solid content and firmness these could be improved by introducing some better practices such as summer and autumn girdling which are widely used in New Zealand. At the present cultural condition, higher dry matter content of organic fruits is considered critically important point for consumer preference. Although organic kiwifruits did not show significant differences statistically in polyphenols and antioxidative capacities the potential increase with those capacities might be achieved by the introduction of organic cultural practices such as better light receptance, reducing vegetative growth and girdling. Higher magnesium content in organic kiwifruit could be related to the fertilization practices but it needs further efforts to any draw conclusion at the moment.

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References

BESCO, E., BRACCIOLI, E., VERTUANI, S., ZIOSI, P., BRAZZO, F., BRUNI, R., SACCHETTI, G. & MANFREDINI, S. (2007): The use of photochemiluminescence for the measurement of the integral antioxidant capacity of baobab products. Food chemistry. 102:1352-1356.

BORDELEAU, G., MYERS-SMITH, I., MIDAK, M. & SZEREMETA, A. (2002): Food Quality: A comparison of organic and conventional fruits and vegetables. Ecological Agriculture, Den Kongelige Veterinoer-og Landbohøskole. The royal veterinary and agricultural university, Frederiksberg, Denmark.

BRANDT, K. & MOLGAARD, J. (2001): Organic agriculture: does it enhance or reduce the nutritional value of plant foods? Journal of the science of food and agriculture. 81:924-931.

BURDON, J., MCLEOD, D., LALLU, N., GAMBLE, J., PETLEY, M. & GUNSON, A. (2004): Consumer evaluation of. Postharvest biology and technology. 34:245-255.

COOK, A., HUNT, L. & FAIRWEATHER, J. (2004): Results from a survey of organic kiwifruit growers: problems and practices that affect production, Lincoln university, Canterbury, NZ.

FERRARIS, L., ABBATISTA-GENTILE, I. & MATTA, A. (1987): Variations of phenols concentrations as a consequence of stresses that induce resistance to Fusariumwildoftomato. Journal of plant disease protection. 94:624-629.

HASEY, J. K., JOHNSON, R. S., MEYER, R. D. & KLONSKY, K. (1995): An organic versus a conventional farming system in kiwifruit. Actahort. 444:223-228.

HEATON, S. (2001): Organic farming, food quality and human health. A review of the evidence, Soil association, Bristol, UK.

TREVELYAN, W. E. & HARRISON, J. S. (1952): Studies on yeast metabolism. 1. Fractionation and microdetermination of cell carbohydrates. 50:298-303.

WOESE, K., LANGE, D., BOESS, C. & BOGL, K. (1997): A comparison of organically and conventionally grown foods-results of a review of the relevant literature. Journal of the science of food and agriculture. 74:281-293.

YAMAGUCHI, F., YOSHIMURA, H., NAKAZAWA, H. & ARIGA, T. (1999): Free radical scavenging activity of grape seed extract and antioxidants by electron spin resonance spectrometry in an H2O2/NaOH/DMSOsystem. Journal of agricultural food chemistry. 47:2544-2548.