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Antioxidant Potential in the Fruits of *Pyrus* Species (Pear) in Korea

Youngki Park†, Sea Hyun Kim, and Hun Gwan Chung

Div. Special Purpose Tree, Korea Forest Research Institute, Suwon 441-350, Korea.

ABSTRACT : Five samples (Bakwoonbae, Chungsilbae, Sandolbae, Dolbae, and Chuwhangbae) of *Pyrus* species differing in their origin of production were analyzed for total phenolic content, vitamin C content, and antioxidant activities. Two antioxidant activities were measured by the free-radical scavenging activity and reducing power method. Total phenolic content of the Chungsilbae extract (20.35 ㎎/g) was higher than those of other pears. Vitamin C content in five *Pyrus* species ranged from 420.32 ㎍/g in Sandolbae to 659.75 ㎍/g in Bakwoonbae. Chungsilbae also had the highest free radical scavenging activity (76.56%) and reducing power (0.35).

Key words **:** *Pyrus* species, total phenolic content, vitamin C content, antioxidant potential

INTRODUCTION

Pyrus species (Pear) are widely cultivated tree in temperature regions especially for their fruit (Pear) uses. Pears have been known to have various physiological activities and have various useful compounds including chlorogenic acid, flavan-3-ols and arbutin (Hamauzu *et al.*, 2007). These polyphenols have shown antioxidant properties, antimutagenic and anticarcinogenic effects (Tanrioven *et al.*, 2005). Antioxidant compounds are produced by the plant to protect the cell against the attack from other cell chemical species such as free radicals and reactive oxygen species (Ferreyra *et al.*, 2007). Antioxidants act by neutralizing free radical activity. The capacity to neutralize free radical activity is based on the properties of phenolic compounds of various chemical structures (eg. catechins, flavonols) and vitamins (C, E, and A) (Fang *et al.*, 2002). Vitamin C, E, and A are essential nutrients as well as play an important role in controlling free radicals as main antioxidant (Yoo *et al.*, 1999).

Although there are more than 2500 minor cultivars and 100 major ones, commercial or available for food pear production is limited to relatively few cultivars (Kim *et al.*, 2005). To select potential cultivar for food, Bakwoonbae (*Pyrus ussuriensis* Max. var. *hakunensis* (Nakai) T. Lee), Chungsilbae (*P. ussuriensis* Max. var. *ovoidea* Rehder), Sandolbae (*P. ussuriensis* Max.), and Dolbae (*P. pyrifolia* (Burm. fil.) Nakai) were collected from different sites and compared with Chuwhangbae (*P. pyrifolia*) grown in orchard for commercial use.

To our knowledge, antioxidant effects and total phenolic contents of *Pyrus* species used in this study have not previously been published yet. Because of the lack of such information, we report, for the first time, total phenolic content and vitamin C content of *Pyrus* species. This study was also conducted to evaluate the antioxidant potential in pears for assessing their biological functions (activities).

MATERIALS AND METHODS

Plant materials

Four *Pyrus* species (Bakwoonbae, Chungsilbae, Sandolbae, and Dolbae), grown in different sites (Gwangyang, Jeongseon, Pyeongchang, and Gokseong, respectively), and commercial cultivar (Chuwhangbae) were utilized.

Extraction

Dried *Pyrus* species fruits were finely ground and extracted with ethanol (EtOH) at 60 ℃ for 30 min and then evaporated to give the crude extract.

Total phenolic contents

Total phenolic contents were measured according to the method of Cheung *et al.* (2003). Each sample (1 ㎖) was mixed with Folin and Ciocalteu's phenol reagent (1 ㎖, Sigma). After 3 min, 1 ㎖ of saturated Na_2CO_3 was added to the mixture and it was made up to 10 ㎖ by adding distilled water. After the reaction was kept in the dark for 90 min, absorbance was taken at 725 ㎚. A calibration curve was constructed with different concentrations of gallic acid (Wako pure chemical Industries) (0.01-0.1 mM) as a standard.

† Corresponding author: (Phone) +82-31-290-1196 (E-mail) ykpark@foa.go.kr
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Vitamin C content

Vitamin C (L-ascorbic acid) was determined by a colorimetric method defined by Jagot and Dani (1982). A 0.5 g sample of dried fruits was weighed and extracted with distilled water then filtered. 0.2 mℓ of extract was mixed with 0.8 mℓ of 10% (w/v) trichloroacetic acid (TCA) at 4℃. After centrifugation at 3000 rpm for 5 min, 0.5 mℓ of supernatant was made up to 2 mℓ volume with distilled water. 0.2 mℓ of 10% (v/v) Folin phenol reagent was then added to the mixture, and vigorously shaken. After 10 min reacted, maximum absorbance was measured at 760 nm. The absorption maximum of the color developed by the interaction of ascorbic acid with Folin reagent was 760 nm.

Free radical scavenging activity

The antioxidant activity was measured by the 1, 1-diphenyl-2-picrylhydrazyl (DPPH) method according to the procedure of Park *et al.* (2006). Ethyl alcohol soluble fraction (0.5 mℓ) of samples at various concentrations was added to a solution of DPPH in EtOH (100 μM, 3 mℓ) and the reaction mixture was shaken vigorously. After incubating the mixtures for 10 min at room temperature, the remaining amounts of DPPH were determined by colorimetry (852A Diode Array Spectrophotometer, Hewlett Packard Co.) at 517 nm. The mixture of 0.5 mℓ of EtOH with a solution of 3 mℓ of DPPH was used as control.

Reducing power

The reducing power was determined according to the method of Oyaizu (1986). Each extract (100 μg/mℓ and 50 μg/mℓ) in EtOH (2.5 mℓ) was mixed with 2.5 mℓ of 0.2 M sodium phosphate buffer (pH 6.6) and 2.5 mL potassium ferricyanide (10 mg/mℓ), the mixture was then incubated at 50 for 20 min. After 2.5 mℓ of trichloroacetic acid (100 mg/mℓ) was added, the mixture was centrifuged and the upper layer (5 mℓ) was mixed with 5 mℓ of distilled water and 1 mℓ of ferric chloride (1 mg/mℓ). The absorbance was measured at 700 nm. Increased absorbance of the reaction mixture indicated increased reducing power.

RESULTS AND DISCUSSION

Total phenolic contents

The total phenolic contents of five Pyrus species fruit are shown in Fig. 1. Total phenolic content in Bakwoonbae, Chungsilbae, Sandolbae, Dolbae, and Chuwhangbae fruit were 19.32 ± 3.29, 20.35 ± 1.64, 17.87 ± 1.06, 19.53 ± 1.34, and 14.04 ± 1.45 mg/g, respectively. This result revealed that total phenolic contents were present in high quantities in Chungsilbae. Since phenolics have been shown to have antioxidant properties and to have protective roles against cancer and vascular disease, it is important to measure the total phenolic content in fruit. Zhang *et al.* (2006) reported that total phenolic contents of Chuwangbae peel, flesh and core were 1.52, 0.32, and 1.43 mg/g, respectively, which were different from our data since they used fresh fruit.

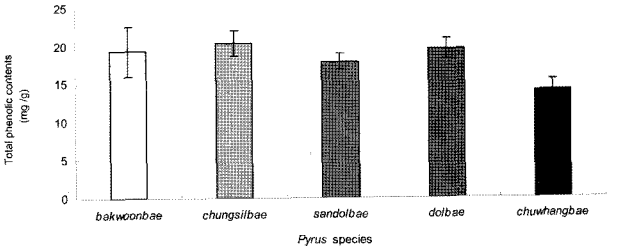

Fig. 1. The total phenolic contents of five *Pyrus* species fruit. The values are mean ± SD (n = 3).

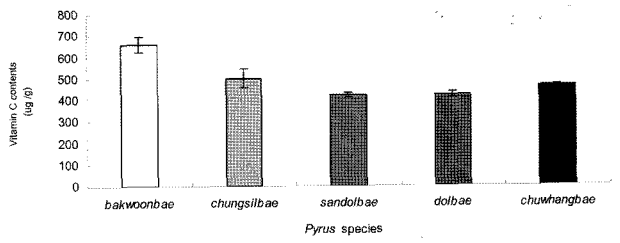

Fig. 2. Vitamin C contents of five Pyrus species fruit. The values are mean ± SD (n = 3).

Vitamin C contents

It was reported that chemical contributors to antioxidant activity in fruit are numerous and included vitamin C (Navarro *et al.*, 2006). Therefore, vitamin C contents of *Pyrus* species are important for antioxidant potential and their nutrient quality assess. Fig. 2 showed the vitamin C contents in the fruit of five *Pyrus* species. As observed in Fig. 2, vitamin C contents of these samples were in the decreasing order of Bakwoonbae (695.75 ± 38.76 μg/g) > Chungsilbae (499.75 ± 43.37 μg/g) > Chuwhangbae (464.28 ± 5.16 μg/g) > Dolbae (422.60 ± 12.43 μg/g) > Sandolbae (420.32 ± 8.42 μg/g). Vitamin C is considered as the most important water-soluble antioxidant and can directly scavenge superoxide radical, singlet oxygen, hydrogen peroxide and hydroxyl radical (Klimczak *et al.*, 2007). According to clinical and epidemiological studies, the recommended daily acceptance for vitamin C is suggested to be 100-120 mg/day to achieve cellular saturation and optimum risk reduction of heart disease, stroke, and cancer in healthy individuals (Naidu, 2003). The vitamin C content in Bakwoonbae

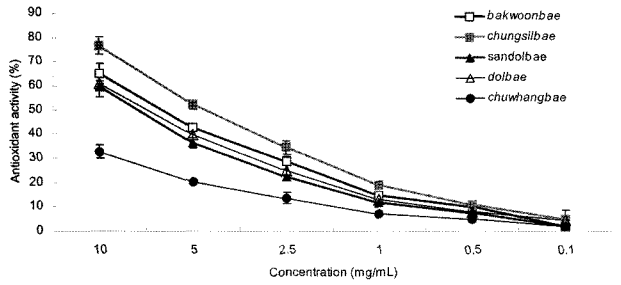

Fig. 3. Free radical scavenging activity of five *Pyrus* species fruit in different concentration. The values are mean ± SD (n = 3).

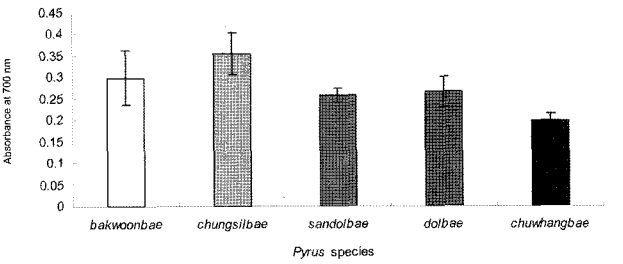

Fig. 4. Reducing power of five *Pyrus* species fruit at 100 ㎍/㎎. The values are mean ± SD (n = 3).

is 69.5 ㎎/100 g: it can deliver about 65% of recommended daily intake of vitamin C.

Antioxidant activity

The free radical scavenging activities of *Pyrus* species fruit are shown in Fig. 3. The free-radical scavenging activities of five *Pyrus* species, Bakwoonbae, Chungsilbae, Sandolbae, Dolbae, and Chuwhangbae, were 65.23 ± 4.21, 76.56 ± 3.61, 59.40 ± 4.26, 60.99 ± 1.28, and 32.73 ± 2.68% at 10 ㎎/㎖, respectively. The antioxidant activity of the *Pyrus* species fruit appeared to be concentration dependent. The highest antioxidant activity of Chungsilbae might be associated with the highest total phenolic content of Chungsilbae in Fig. 1. The free radical scavenging activities of *Pyrus* species fruit were associated with total phenolic contents in fruits (Fig. 1 and Fig. 3). It has been reported that the antioxidant activity was closely correlated with phenolic compound content (Park *et al.*, 2005).

Reducing power

Reducing powers of the fruit of *Pyrus* species were measured using the potassium ferricyanide method (Fig. 4). A higher absorbance indicates higher reducing power. As observed in Fig. 4, reducing powers of five *Pyrus* species were in the decreasing order of Chungsilbae (0.35 ± 0.05) > Bakwoonbae (0.29 ± 0.06) > Dolbae (0.26 ± 0.04) > Sandolbae (0.25 ± 0.02) > Chuwhangbae (0.19 ± 0.02). Since it was reported that reducing power has been found to be associated with the antioxidant activity (Siddhuraju *et al.*, 2002), the order of reducing power of *Pyrus* species were same as the order of antioxidant activity in Fig. 3. The highest reducing power is observed in Chungsilbae, also showing that reducing power of *Pyrus* species is related to the total phenolic content. It was also studied that reducing power of grape seed was associated with its antioxidant (Jayaprakasha *et al.*, 2001).

To select potential cultivar for food and assess antioxidant potential, we measured total phenolic content, vitamin C content and antioxidant activities in Bakwoonbae, Chungsilbae, Sandolbae, and Dolbae collected from different sites and Chuwhangbae grown in orchard. From the results obtained in this study, we could suggest that Chungsilbae has the highest antioxidant and total phenolic content among five *Pyrus* species. Vitamin C content in Bakwoonbae is higher than those of others. Therefore, Chungsilbae and Bakwoonbae grown in mountain have potential to be cultivate in orchard for functional pear variety breeding.

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