Comparison of the Contents of Bioactive Compounds and the Level of Antioxidant Activity in Different Kiwifruit Genotypes

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Keywords: Bioactive Compounds, Antioxidant Activity, Kiwifruit, Genotypes.

Abstract. Fruit of seven \textit{Actinidia} genotypes were tested for their polyphenol composition and vitamin C contents and evaluated for antioxidant potential by several assays (DPPH, ABTS and FRAP). It is concluded that significant genotypic difference exists in the total antioxidant capacity of \textit{Actinidia} fruits. \textit{A. eriantha} and \textit{A. latifolia} had highest content of total polyphenols, total flavonoids and vitamin C, \textit{A. arguta} and \textit{A. callosa var. henryi Maximowicz} had highest total flavanols content, while \textit{A. arguta} and \textit{A. chinensis cv. Hongyang} had highest total anthocyanin content in tested-genotypes. The results showed that the antioxidant capacity of \textit{A. eriantha} and \textit{A. latifolia} fruits were significantly higher than that of other genotypes.

Introduction

In the recent years, food and nutrition experts agree that daily consumption of fruits and vegetables plays a special role in prevention and treatment of various diseases, including cancer and cardio and cerebrovascular diseases [1,2,3]. The health benefits of fruits and vegetables are attributable in part to their bioactive components such as phenolics, pectic polysaccharides, ascorbic acid, carotenoids and tocopherols [4,5]. Fruits and vegetables contain significant levels of biologically active substances that have physiological and biochemical benefits and are important for human health [6].

As one of the most popular fruits today, kiwifruit (\textit{Actinidia}) is characterized by a high vitamin C content and other useful compounds such as vitamin E, carotenoids, flavonoids, minerals and others. \textit{Actinidia} had rich germplasm resources, including 54 species and 21 varieties [7]. Up to now, the main cultivars in the world originates in \textit{A. chinensis} and \textit{A. chinensis var. deliciosa}, for example ‘Hayward’, ‘Hort 16A’ and ‘Hongyang’. A few investigators in the past have used a wide range of assays to determine the antioxidant compounds content and activity in some species and varieties, but most researches concentrate mainly on \textit{A. chinensis}, \textit{A. chinensis var. deliciosa} and \textit{A. arguta} [8,9,10], the antioxidant properties of other species and varieties were not clear until now.

Hence, in this study, seven different experimental materials of \textit{Actinidia} were used to assess and compare the antioxidant properties. This assessment was made on the basis of a comprehensive study of the chemical composition, nutritional value and bioactivity of fruits.

Materials and Methods

Samples

Peeled fruits of \textit{Actinidia}, including \textit{A. arguta}, \textit{A. callosa var. henryi Maximowicz}, \textit{A. chinensis cv. Hongyang}, \textit{A. chinensis var. deliciosa cv. Qinmei}, \textit{A. eriantha}, \textit{A. latifolia} and \textit{A. polygama}, were obtained from Kiwifruit Resource Orchard in Shifang (104°16′N, 31°13′E), China. Fruits were selected in batches according to the uniformity of the shape when all fruits samples have reached physiological maturity.
Preparation of Kiwifruit Extracts

50 g flesh was homogenized and extracted in 200 mL of ethanol:acetone (7:3, v/v) for 1 h at 37°C. The extract was filtered through Whatman No. 41 paper and rinsed with 50 mL of ethanol:acetone (7:3, v/v). The residue of the first extract was repeated using the same conditions. The two filtrates were combined and then stored at 20°C until used for analysis of the total phenolics, total flavonoids, total flavanols and antioxidant capacity.

Determination Content of Total Polyphenols, Total Flavonoids, Total Flavanols, Total Anthocyanin and Vitamin C

Total polyphenols content (TPC) was determined using the Folin-Ciocalteu method [11]. The absorbance was read at 765 nm, and the total polyphenols concentration was calculated from a calibration curve, using gallic acid as standard (50-1000 mg/L). Total flavonoids content (TFC) was determined following [12]. The total flavonoids concentration was measured at 506 nm calculated from a calibration curve using rutin as standard (6.25-300 mg/L). Total flavanols content (TFAC) was determined using the slightly modified DMACA method [13]. The concentration of TFA was estimated from a calibration curve developed using catechin (6.25-200 mg/L). Vitamin C (Vc) was assayed according to [14]. A standard curve of vitamin C was used for calibration. The total monomeric anthocyanin content (TMAC) was estimated by the pH differential method. The TMAC were expressed in terms of cyanidin-3-glucoside [15].

Antioxidant Capacity Determined by DPPH, ABTS, and FRAP

The ability to scavenge DPPH (2,2-diphenyl-1-picrylhydrazyl) free radicals was determined based on the method of [16]. Results were expressed as trolox equivalent antioxidant capacity. ABTS (2,2’-azino-bis-(3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt) radical cation (ABTS·+) assay was based on the method of [17]. Results were expressed as trolox equivalent antioxidant capacity. The FRAP (ferric reducing antioxidant power) assay was done according to [18] with some modifications. Results were expressed as trolox equivalent antioxidant capacity.

Results and Discussion

Polyphenol Composition and Vitamin C Content of Different Actinidia Genotypes

Values for TPC differed significantly among Actinidia genotypes, ranging from 207.2 to 1540.0 mg GAE/100g FW in the flesh (Table 1). A. latifolia contained the highest contents of total phenolics in both peel and flesh whereas the lowest values for that parameter were found in A. chinensis var. deliciosa cv. Qinmei.

For all varieties, the TFC ranged from 7.9 to 59.7 mg rutin/100 FW in the flesh of different genotypes. A. eriantha contained the highest contents of flavonoids in the flesh, whereas the lowest values were measured from A. arguta (Table 1).

Values for TFAC in the peel ranged from 12.0 to 237.4mg catechin/100 FW (Table 1). A. callosa var. henryi Maximowicz contained the highest TFAC while the lowest was found in A. latifolia.

Among all tested kiwifruit flesh, TMAC was the highest in A. chinensis cv. Hongyang (43.1 mg cyanidin 3-glucoside/kg FW, a red-flesh variety) and the lowest in A. chinensis var. deliciosa cv. Qinmei (5.37 mg cyanidin 3-glucoside/kg FW, a green-flesh variety) (Table 1).

Vitamin C content varied from 53.4 to 1940.4 as mg ascorbic acid/100 g fresh weight. A. latifolia and A. eriantha had the highest vitamin C content, whereas A. callosa var. henryi Maximowicz had the lowest vitamin C content (Table 1).

These results suggested that kiwifruit are a better source of antioxidant compounds and had significant difference in levels and types in different genotypes. Our finding was similarly with others researches, they observed that the phenolic compounds and vitamin C contents showed a great variety amongst Actinidia genotypes [8,10,19].
Table 1. Contents of Total Polyphenols, Flavonoids, Flavanols, Vitamin C and Anthocyanin in Fruit Extracts from 7 Genotypes of Actinidia.

<table>
<thead>
<tr>
<th>Sample</th>
<th>TPC</th>
<th>TFC</th>
<th>TFAC</th>
<th>Vc</th>
<th>TMAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. arguta</td>
<td>213.3±4.5</td>
<td>7.9±0.4</td>
<td>133.1±4.5</td>
<td>112.4±9.4</td>
<td>41.0±2.1</td>
</tr>
<tr>
<td>A. callosa var. henryi Maximowicz</td>
<td>388.6±20.9</td>
<td>28.0±1.0</td>
<td>237.4±9.5</td>
<td>53.4±3.0</td>
<td>7.9±1.2</td>
</tr>
<tr>
<td>A. chinensis cv. Hongyang</td>
<td>295.8±25.1</td>
<td>21.6±1.3</td>
<td>28.4±3.6</td>
<td>93.8±7.6</td>
<td>43.1±2.6</td>
</tr>
<tr>
<td>A. chinensis var. deliciosa cv. Qinmei</td>
<td>207.2±18.4</td>
<td>17.5±1.5</td>
<td>15.5±1.7</td>
<td>160.1±8.2</td>
<td>5.37±0.5</td>
</tr>
<tr>
<td>A. eriantha</td>
<td>1114.5±53.6</td>
<td>59.7±0.6</td>
<td>118.7±2.4</td>
<td>1220.6±155.3</td>
<td>18.4±0.5</td>
</tr>
<tr>
<td>A. latifolia</td>
<td>1540.0±123.3</td>
<td>55.0±6.1</td>
<td>12.0±1.3</td>
<td>1940.4±125.1</td>
<td>6.9±0.9</td>
</tr>
<tr>
<td>A. polygama</td>
<td>219.2±25.0</td>
<td>12.8±1.1</td>
<td>50.7±4.6</td>
<td>79.3±4.4</td>
<td>13.9±1.9</td>
</tr>
</tbody>
</table>

Note: TPC (mg gallic acid/100 g FW); TFC (mg rutin/100 g FW); TFAC (mg catechin/100 g FW); Vc (mg ascorbic acid/100 g FW); TMAC (mg cyanidin 3-glucoside/1000g FW). Values are means of 3 replicates ± SD.

Antioxidant Capacity of Different Actinidia Genotypes Extracts

The antioxidant capacity of all Actinidia extracts were evaluated with the DPPH, ABTS and FRAP tests (Table 2). The free radical scavenging activity determined by DPPH varied from 2.1  to 21.1µM TE/g FW and the values determined by ABTS ranged from 25.5  to 205.4µM TE/g FW. In the FRAP assay, the ability of Actinidia extracts to reduce Fe³⁺ to Fe²⁺ ranged from 187.7to 4095.0µM TE/g FW. In all test methods, the antioxidant capacity of A. eriantha and A. latifolia was stronger than that of other genotypes of Actinidia fruit, whereas main cultivars, ‘Hongyang’ and ‘Qinmei’, were weaker. Du et al.[8] also observed that the wild A. eriantha and A. latifolia species have significantly higher antioxidant capacity than the main cultivars.

Table 2. The Antioxidant Activity (µM TE/g FW) in Seven Kiwifruit Genotypes.

<table>
<thead>
<tr>
<th>Sample</th>
<th>DPPH</th>
<th>ABTS</th>
<th>FRAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. arguta</td>
<td>10.3±0.8</td>
<td>26.6±0.6</td>
<td>187.7±2.2</td>
</tr>
<tr>
<td>A. callosa var. henryi Maximowicz</td>
<td>10.3±0.1</td>
<td>31.5±0.6</td>
<td>217.4±2.5</td>
</tr>
<tr>
<td>A. chinensis cv. Hongyang</td>
<td>4.7±0.4</td>
<td>58.8±3.4</td>
<td>502.4±3.6</td>
</tr>
<tr>
<td>A. chinensis var. deliciosa cv. Qinmei</td>
<td>11.8±0.7</td>
<td>38.5±0.6</td>
<td>400.5±4.7</td>
</tr>
<tr>
<td>A. eriantha</td>
<td>21.1±0.5</td>
<td>205.4±4.6</td>
<td>3521.9±87.2</td>
</tr>
<tr>
<td>A. latifolia</td>
<td>19.9±0.2</td>
<td>181.5±14.3</td>
<td>4095.0±77.3</td>
</tr>
<tr>
<td>A. polygama</td>
<td>2.1±0.1</td>
<td>25.5±1.1</td>
<td>565.7±14.6</td>
</tr>
</tbody>
</table>

Note: Values are means of 3 replicates ± SD.

References


