

Evaluation of antioxidant activity of indigenous vegetables from South and Southeast Asia

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Objectives

More than eight hundred million people currently suffer from hunger and malnourishment. Improving the production of principal food crops such as rice, wheat, corn and root crops has thus become one of the most important research subjects in the field of agriculture. Yet, sufficient levels of micronutrients and vitamins are also essential for maintaining good health, especially for pregnant women and preschool children in rural areas. Since vegetables can provide high levels of micronutrients, vitamins and fiber, producing more vegetable varieties has become an important task. To help develop vegetable variety, indigenous vegetables that are under-utilized globally but sufficiently adopted to local areas in growth and taste preferences (Fig. 1) can be of great value. The purpose of this study, conducted in collaboration with the Asian Vegetable Research and Development Center (AVRDC), has been to select the most superior indigenous leaf vegetables based on functional properties.

Results

To complete this objective, various accessions of indigenous vegetables from South and Southeast Asia were evaluated for their antioxidant activity, levels of ascorbic acid (vitamin C), and total phenol count. Antioxidant activity was assayed by a modified thiocyanate method using ethanol extracts; total phenolic compounds were determined by the Folin-Denis method using the same ethanol extracts; and ascorbic acid content was evaluated by RQflex and use of analytical test strips. These methods do not require the use of expensive analytical instruments such as high performance liquid chromatography (HPLC).

Among the twenty tested vegetable varieties, the top nine were determined to have young shoots and leaves with extremely strong antioxidant activity. These include Chinese mahogany (*Toona sinensis*), Horseradish tree (*Moringa* spp.), Feather cockscomb (*Celosia argentea*), Perilla (*Perilla frutescens*), Pigeon pea (*Cajanus cajan*), Black nightshade (*Solanum nigrum* or *S. americanum*), Ailanthus (*Zanthoxylum ailanthoides*), Capsicum pepper (*Capsicum annuum*) and White jute (*Corchorus* spp.). These vegetables also had a tendency to have higher ascorbic acid and total phenol contents (Table 1). Antioxidant activity, ascorbic acid and total phenol contents differed not only among vegetable species but also among accessions (Table 2).

For the selection of superior indigenous vegetables, evaluation of antioxidant activity, ascorbic acid and total phenol contents can be used as a novel index together with morphological and ecological characterization, and yield evaluation.



Fig. 1. Genetic diversity of Amaranth or Chinese spinach (*Amaranthus* spp.).

Table 1. The highest rated indigenous leafy vegetables in terms of antioxidant activity, ascorbic acid and total phenol contents at the AVRDC.

Indigenous leafy vegetables/ Young shoots of fruit vegetables	Scientific name	Antioxidant activity ¹	Ascorbic acid content ²	Total phenol content ³
(Antioxidant activity : Strong)				
1 Chinese mahogany	<i>Toona sinensis</i>	128	(125)	(3,784)
2 Leaf of horseradish tree (Mo13)	<i>Moringa oleifera</i>	115	(287)	(691)
3 Feather cockscomb (purple)	<i>Celosia argentea</i>	114	(134)	(947)
4 Perilla	<i>Perilla frutescens</i>	114	84	(727)
5 Leaf of pigeon pea	<i>Cajanus cajan</i>	113	(259)	(833)
6 Leaf of horseradish tree	<i>Moringa</i> spp.	113	(245)	(713)
7 Leaf of black nightshade	<i>Solanum nigrum</i>	112	(146)	432
8 Ailanthus	<i>Zanthoxylum ailanthoides</i>	111	82	(2,134)
9 Leaf of capsicum pepper (purple)	<i>Capsicum annuum</i>	108	(226)	(1,158)
10 White jute	<i>Corchorus</i> spp.	107	(153)	503
11 Leaf of African eggplant	<i>Solanum macrocarpon</i>	105	120	537
12 Leaf of Chinese wolfberry	<i>Lycium chinense</i>	105	116	597
13 Parsley	<i>Petroselinum crispum</i>	104	(132)	271
14 Leaf of capsicum pepper	<i>Capsicum</i> spp.	99	(128)	(817)
15 Basil	<i>Ocimum basilicum</i>	99	28	302
16 Water convolvulus	<i>Ipomoea aquatica</i>	99	45	(726)
17 Gynura	<i>Gynura bicolor</i>	97	35	313
18 Madeira-vine	<i>Anredera cordifolia</i>	97	59	232
19 Dandelion	<i>Taraxacum officinale</i>	96	27	137
20 Sweet potato vine	<i>Ipomoea batatas</i>	96	35	684
(Antioxidant activity : Weak)				

Data in parentheses represent the top ten vegetables in terms of ascorbic acid and total phenol content.

¹Relative value against 10 mM BHA positive control (%).

²Ascorbic acid content (mg/100g FW).

³Total phenol content (mg chlorogenic acid equivalent/100g FW).

Table 2. Diversity of antioxidant activity, ascorbic acid and total phenol contents in young shoots and leaves of indigenous vegetables from South and Southeast Asia.

Indigenous vegetables (Scientific name)	No. of accessions	Antioxidant activity ¹	Ascorbic acid ²	Total phenol content ³
		Max – Min	Max – Min	Max – Min
1 Perilla (<i>Perilla frutescens</i>)	7	118 – 110	98 – 67	1,039 – 479
2 Pigeon pea (<i>Cajanus cajan</i>)	51	116 – 86	259 – 78	1,348 – 757
3 Horseradish tree (<i>Moringa</i> spp.)	26	118 – 92	323 – 158	983 – 566
4 Black nightshade (<i>Solanum nigrum</i>)	18	116 – 108	178 – 128	570 – 357
5 White jute (<i>Corchorus</i> spp.)	49	110 – 100	216 – 70	666 – 318
6 Water convolvulus (<i>Ipomoea aquatica</i>)	72	116 – 80	68 – 31	1,324 – 478
7 Capsicum pepper (<i>Capsicum</i> spp.)	22	108 – 93	226 – 82	1,158 – 428
8 Basil (<i>Ocimum basilicum</i>)	11	107 – 87	31 – 23	481 – 182
9 Spider flower (<i>Cleome gynandra</i>)	17	97 – 91	160 – 113	322 – 243
10 Garland chrysanthemum (<i>Chrysanthemum coronarium</i>)	20	96 – 89	57 – 35	343 – 210
11 Amaranth (<i>Amaranthus</i> spp.)	100	103 – 33	135 – 28	452 – 124
12 Malabar spinach (<i>Basella alba</i>)	78	94 – 35	154 – 53	547 – 211

¹Final concentration of BHA was 40 μM and that of sample was 2 mg (FW)/mL.

Antioxidant activity (AOA) : AOA (%) of sample/AOA (%) of 10mM BHA × 100.

²Ascorbic acid content (mg/100g FW).

³Total phenol content (mg chlorogenic acid equivalent/100g FW).

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