Blueberries and Antioxidant Activity

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U S H I G H B U S H B L U E B E R R Y C O U N C I L

Antioxidants help to neutralize free radicals, which are unstable molecules that are linked to the development of a number of degenerative diseases and conditions including cancer, cardiovascular disease, cognitive impairment, immune dysfunction, cataracts and macular degeneration. Fruits and vegetables are sources of natural antioxidants and among them blueberries have one of the highest levels of antioxidant activity.

The following research excerpts including on the antioxidant capacity of blueberries are provided for information purposes. Antioxidant levels may be affected by fruit maturity at harvest, growing condition, type of cultivar, and other variables.

Wu X, Beecher GR, Holden JM, Haytowitz DB, Gebhardt SE, Prior RL. "Lipophilic and hydrophilic antioxidant capacities of common foods in the United States," Journal of Agricultural and Food Chemistry, 2004, 52:4026-4037.
The oxygen radical absorbance capacity (ORAC) assay was used to measure both lipophilic and hydrophilic antioxidant capacities in fruits, including blueberries, vegetables, nuts, dried fruits, spices, cereals, infant, and other foods. Total antioxidant capacity (TAC) was calculated by combining lipophilic $ORAC_{FL}$ and hydrophilic $ORAC_{FL}$ values. Cultivated blueberries had a TAC of 62.20 µmol of TE/g or 9019 µmole of TE/1 cup serving. When the foods were categorized into four groups ranked by their hydrophilic $ORAC_{FL}$ per serving values, blueberries ranked in the top quartile.

Howard LR, Clark JR, Brownmiller C. "Antioxidant capacity and phenolic content in blueberries as affected by genotype and growing season," Journal of the Science of Food and Agriculture, 2003, 83:1238-1247.
This study compared the total phenolics (TPH), total anthocyanins (ACY), total hydroxycinnamic acids (HCA), total flavonols (FLA), fruit weight and oxygen radical-absorbing capacity (ORAC) of 18 blueberry genotypes grown over two growing seasons at the same locations. ORAC, TPH, ACY, HCA, FLA and fruit weight levels were affected more by genotype than by growing seasons. However, the ORAC and phenolic content of some genotypes varied over the two growing seasons, suggesting that environmental growing conditions can affect levels of phenolics and ORAC in blueberries. The authors suggest that blueberry genotypes should be screened over several growing seasons in order to identify germplasm rich in antioxidants and phenolics.

Zheng W, Wang SY. "Oxygen radical absorbing capacity of phenolics in blueberries, cranberries, chokeberries, and lingonberries," Journal of Agricultural and Food Chemistry, 2003, 51:502-509.
Antioxidant activity of phenolic compounds in blueberries and other berries and the activity-structure relationships of flavonoids and phenolic acids using the oxygen radical absorbance capacity assay (ORAC) were investigated. ORAC, anthocyanin and total phenolic content of blueberries (cv. Serra) was 28.9 umol of TE/g, 1.20 mg cyanidin 3-glucoside equivalents/g and 4.12 mg gallic acid equivalents/g respectively. Blueberries contained the phenolic compounds chlorogenic acid, myricetin, quercetin and kaempferol. Chlorogenic acid (20.9% of the ORAC value) was a major contributor to antioxidant activity due to its high concentration in blueberries. The combination of the 11 anthocyanins found in blueberries accounted for 56.3% of the total ORAC value.

Sellappan S, Akoh CC, Krewer G. "Phenolic compounds and antioxidant capacity of Georgia-grown blueberries and blackberries," Journal of Agricultural and Food Chemistry, 2002, 50:2432-2438.
A variety of Rabbiteye blueberry (V*accinium ashei)* cultivars and Southern highbush blueberry (*Vaccinium corymbosum)* cultivars were collected and analyzed for flavonoids, phenolic acids, total anthocyanins, total polyphenols, and Trolox-equivalent antioxidant capacity (TEAC). Phenolic acids measured were gallic acid, p-hydroxybenzoic acid, caffeic acid, p-coumaric acid, ferulic acid and ellagic acid. Flavonoids measured were catechin, epicatechin, myricetin, quercetin and kaempferol. Rabbiteye blueberry, Tifblue, had the highest concentration of gallic acid (258.90 mg/100g) and ferulic acid (16.97 mg/100 g). Some cultivars contained ellagic acid, which ranged from 0.75-6.65 mg/100 g FW in the southern highbush and from 0.19-6.02 mg/100 g in the rabbiteye blueberries.

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Research Excerpts: Blueberries and Antioxidant Activity

Moyer RA, Hummer KE, Finn CE, Frei B, Wrolstad RE. "Anthocyanins, phenolics, and antioxidant capacity in diverse small fruits: Vaccinium, Rubus, and Ribes," Journal of Agricultural and Food Chemistry, 2002, 50:519-525.
Anthocyanin, phenolic and antioxidant capacity content of nine *Vaccinium*, seven *Rubus* and five *Ribes* species was measured. Within *Vaccinium corymbosum* L., the mean anthocyanin and phenolic content was 208 mg/100 g and 444 mg/100 g, respectively. Fruit size was highly correlated with anthocyanin content. Mean antioxidant activity was 52.3 umol TE/g based on the ORAC assay and 58.6 umol/g based on the FRAP assay.

Ehlenfeldt MK, Prior RL. "Oxygen radical absorbance capacity (ORAC) and phenolic and anthocyanin concentrations in fruit and leaf tissues of highbush blueberry," Journal of Agricultural and Food Chemistry, 2001, 49:2222-2227.
The study compared total phenolics and anthocyanins concentrations and antioxidant capacity (ORAC) in 87 highbush blueberry cultivars. Average values for ORAC, phenolics and anthocyanins in fruit were 15.9 ORAC units/g, 0.95 mg gallic acid equivalents/g, and 1.79 mg cyanidin-3-glucoside equivalents/g, respectively.

Wang SY, Jiao H. "Scavenging capacity of berry crops on superoxide radicals, hydrogen peroxide, hydroxyl radicals, and singlet oxygen," Journal of Agricultural and Food Chemistry, 2000, 48:5677-5684.
The fruit juice from the Bluecrop and Elliot cultivars of blueberries and other berries, was evaluated for antioxidant activity against superoxide radicals, hydrogen peroxide, hydroxyl radicals and singlet oxygen. Juice from Elliot blueberries was among the juices with the highest antioxidant capacity against superoxide radicals, hydrogen peroxide, hydroxyl radicals and singlet oxygen.

Cao G, Shukitt-Hale B, Bickford PC, Joseph JA, McEwen J, Prior RL. "Hyperoxia-induced changes in antioxidant capacity and the effect of dietary antioxidants," Journal of Applied Physiology, 1999, 86:1817-1822.
A hyperoxia-induced redistribution of proteins and antioxidants between blood stream, lung, and pleural effusion was partially blocked in lab animals fed a diet supplemented with blueberry extract for eight weeks.

Prior RL, Cao G, Martin A, Sofic E, McEwen, J, O'Brien C Lischner N, Ehlenfeldt M, Kalt W, Krewer G, Mainland CM. "Antioxidant capacity as influenced by total phenolic and anthocyanin content, maturity, and variety of *Vaccinium* species," Journal of Agricultural and Food Chemistry, 1998, 46:2686-2693.
Different cultivars of four *Vaccinium* species were analyzed for total phenolics, total anthocyanins, and antioxidant capacity. Oxygen radical absorbance capacity (ORAC) ranged from 13.9 to 42.3 umol/g in *Vaccinium corymbosum* and *Vaccinium ashei* which was higher than levels found in other fruits and vegetables previously tested.

Antioxidant Fruit Power!

The USDA Human Nutrition Research Center on Aging in Boston has developed an assay, called ORAC (oxygen radical absorbance capacity), which quantifies the antioxidant capacity of foods. Fresh blueberries have a high level of ORAC, 2400 per 100 grams. Five servings of some fruits and vegetables in a typical American diet have an ORAC score of 1600. From an antioxidant capacity standpoint, 100 grams (3.5 oz.) of fresh blueberries could deliver the equivalent antioxidant capacity of five servings of some fruits and vegetables — a good reason to include blueberries as part of a varied diet.

Cao G, Booth SL, Sadowski JA, Prior RL. Increases in human plasma antioxidant capacity after consumption of controlled diets high in fruit and vegetables. American Journal of Clinical Nutrition. 1998, 68:1081-1087.

Prior RL, Cao G, Martin A, Sofic E, McEwen, J, O'Brien C Lischner N, Ehlenfeldt M, Kalt W, Krewer G, Mainland CM. "Antioxidant capacity as influenced by total phenolic and anthocyanin content, maturity, and variety of Vaccinium species," Journal of Agricultural and Food Chemistry, 1998, 46:2686-2693.

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