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**FILE:** · *Vaccinium* spp.  
· Antioxidant Activity  
· Bilberry (*Vaccinium myrtillus*)

**DATE:** January 15, 2000

HC 100792

**RE: Antioxidant Activity of Berries in the Genus *Vaccinium***

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

Fruits and vegetables contain several different phytonutrients, many of which have antioxidant properties, including flavonoids (compounds such as flavones, isoflavones, flavonones, anthocyanins and catechins). The disease protection provided by fruits and vegetables has been attributed to the various antioxidants they contain. However, there have been few attempts to quantify the total antioxidant capacity in foods. Studies from the author's laboratory were the first attempt to accurately measure the total antioxidant capacity of fruits and vegetables. The oxygen radical absorbance capacity (ORAC) procedure, an automated analysis of the antioxidant capacity of foods, lends itself well to identifying foods with high antioxidant capacity and to evaluate in vivo responses to dietary antioxidant manipulation. Antioxidant capacity is measured in Trolox equivalents per gram (TE/g) of fresh weight.

Blueberries are of specific interest because of their high antioxidant capacity (in some cases as high as 40-50  $\mu$ moles TE/g). By comparison, kale, strawberries and spinach had relatively high antioxidant capacities of 17.7, 15.4 and 12.6  $\mu$ mol TE/g. At the author's laboratory at the U.S. Department of Agriculture, Agriculture Research Service, Jean Mayer Human Nutrition Research Center on Aging, Tufts University, studies were done to evaluate different cultivars of four *Vaccinium* species. The purpose was to compare total phenolics, total anthocyanins and antioxidant capacity in berry samples from selected cultivars of the *Vaccinium* species [*V. corymbosium* (highbush), *V. ashei* Reade (rabbiteye), *V. angustifolium* (lowbush), and *V. myrtillus* L (bilberry)]. Samples from three locations within the U.S. (New Jersey, Michigan, and Oregon) were obtained for *V. corymbosium* to evaluate the differences in climate or growing conditions on the antioxidant capacity. Bilberry was included in the sampling because of its long history in folk medicinal use.

Total antioxidant capacity, measured as Oxygen Radical Absorbance Capacity (ORAC), ranged from a low of 13.9 to 45.9  $\mu\text{mol TE/g}$  of fresh berries in extract. Bilberry and the lowbush blueberries from Nova Scotia had the highest antioxidant capacity as well as total phenolics. Ascorbate (vitamin C) was not a significant contributor to the measured antioxidant activity of any of the blueberries samples. Several highbush varieties and the late harvest on the rabbiteye had ORAC values that approached those observed for the bilberry. Maturity at harvest had a marked effect on ORAC, the total anthocyanins and the total phenolics of the berries. Location, however, did not affect the ORAC value, the anthocyanin or the total phenolic content of the highbush blueberries. Highbush and lowbush blueberries are the primary species of blueberries used by the food industry in the U.S.

Because the anthocyanins seem to be concentrated in the skin of the blueberry (the bilberry may be an exception) it is expected that the total anthocyanins would increase in proportion to the calculated surface area/volume ratio of the blueberries. However, changes in anthocyanin content at different stages of maturity can cause this relationship to break down (i.e., for some cultivars, anthocyanins increased markedly with maturity, but the surface area/volume estimate did not change).

Several studies have been done with a highly purified extract of *V. myrtillus*, designated Myrtocyan, which contains 36% anthocyanosides. However, studies have not been done to determine whether consumption of anthocyanins from *Vaccinium* species might have similar health benefits. On the basis of the results from this study, the authors concluded that other species of other *Vaccinium* might be good sources of anthocyanins and other antioxidants. The authors have previously estimated the normal intake of antioxidants as measured by ORAC within the U.S. to be between 1.2-1.7 mmol ORAC/day. Some individuals have been observed to have ORAC intakes as high as 6 mmol/day. Consumption of  $\frac{1}{2}$  cup of blueberries/day would increase ORAC intake by 1.32 mmol, depending upon the blueberry variety and maturity. Thus, the ORAC of the blueberry source can have marked effects on the total daily ORAC intake. —*Densie Webb, Ph.D.*

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